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Acquisition, Technology and Logistics

3D Printing

How Much Will It Improve the DoD Supply Chain of the Future?

Protecting the Future
By the Under Secretary of Defense for Acquisition, Technology and Logistics

Predicting Weapon Effects for Defense and Homeland Security

Integrated Cost Analysis Teams
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Protecting the Future

Frank Kendall

I f you've heard me speak recently or read about any of my recent congressional testimony, you may be aware that I'm fairly vocal about my concerns regarding our ability to sustain the unchallenged technological superiority our military has enjoyed for several decades. This isn't a new concern but, given the budget cuts we face and the difficult trade-offs among competing needs for force structure, readiness and investment, I decided it was time to be much more public and vocal about our current and future risks. The Secretary and the acting Deputy Secretary have been extremely supportive and are expressing the same concerns.

One of my priorities as USD(AT&L) is "Protect the Future." In October 2011, I added this item to the list of priorities I had articulated as Principal Deputy Under Secretary in 2010. "Protect the Future" spans several areas. It includes keeping alive the capabilities we developed to support the two prolonged counter-insurgency campaigns we have waged in Iraq and Afghanistan—we may need them again. On this list are items like contingency contracting, counters to improvised explosive devices, and rapid acquisition in general. "Protecting the future" includes the protection of our science and technology accounts. It would also include protecting the gains we have made in staffing and training the acquisition workforce using the Defense Acquisition Workforce Fund. Most of all, however, I am concerned about protecting the adequacy of our research and development (R&D) investments in capabilities and systems that will allow us to dominate on future battlefields and keep engineering design teams who develop advanced defense systems.

The Department is dealing with an unprecedented level of uncertainty about our future budgets. It is normal to have a small gap between the requested budget and the appropriated one, but not on the order with which we have been forced to cope. The large gap between the budgets we have been requesting and what we could receive under sequestration is a planning nightmare. The President's budget this year acknowledges this disconnect. We are asking for a fiscal year 2015 (FY15) number that complies with the Bipartisan Budget Act, but the President is appropriately requesting additional funds for defense in the Opportunity, Growth and Security Initiative. In FY16 and beyond, our request narrows the gap between sequestration and our request by about half, but this still leaves us with a significant band of uncertainty. Whatever the ultimate result, we live in a world of reduced resources and a world in which we may plan based on an assumption of substantially more resources than may actually be provided.

In this environment there is a tendency to hang on to what we have—namely, force structure and programs that are already in production. There is also a strong desire to keep the readiness of our forces at acceptable levels. Having lived through the readiness crisis of the 1970s as an Army officer stationed in West Germany, I can appreciate this desire. Nevertheless I will continue to argue that we need to properly balance readiness, force structure and modernization, while preserving our R&D activities. Here are three reasons why I believe preservation of research and development is necessary.

First, technological superiority is not assured. Ever since returning to government service in spring of 2010, I begin my day with an intelligence update. Because of my role, I tend to focus more than most senior leaders on technical intelligence. While a conflict with any specific power may be unlikely, it was immediately apparent to me four years ago (and nothing has changed this view except to reinforce it) that China in particular, as well as Russia and other states, are developing cutting-edge military capabilities that are designed to defeat current and planned U.S. capabilities. We have had the luxury of living for a long time off technological capital largely developed during the Cold War. We demonstrated dominant operational effectiveness in the first Gulf War, which was won in a very short time with many fewer casualties than anyone expected. Our advances in stealth, precision weapons, networking and wide-area surveillance combined to give us an unprecedented level of military capability. We used these same fielded technologies in Serbia, in Afghanistan and in the invasion of Iraq. Potential adversaries saw what we had demonstrated so clearly over 20 years ago, and they took action. In the meantime, I'm afraid we have been complacent and tended to take our technological advantage for granted.

> **I will continue to argue that we need to properly balance readiness, force structure and modernization, while preserving our research and development activities.**

We also have been focused for more than a decade on intense counter-insurgency campaigns.

What areas concern me the most? The areas we refer to loosely as A2AD for Anti-Access and Area Denial. Our ability to project power around the globe depends on an array of assets and actions that include our space-based global-positioning systems, our communications and sensors, our long-range strike, our ability to move carrier-based strike forward, our networks, forward basing (including airfields and command, control and communication as well as logistics nodes), and our ability to be dominant in the air. These are all areas in which we are being challenged with both current capabilities and capabilities still in development. This bears repeating. While a conflict with any specific power may be unlikely, I do not want to live in a world in which the United States no longer is the dominant military power or in which potential adversaries may possess equipment (from any source) that would remove the advantage our warfighters have depended on for so long.

My second point is that R&D is not a variable cost. This is not an obvious point to many people, and in the past there has been a tendency to reduce R&D more or less proportionately to other budget reductions. This can be dangerous, if done in excess, because R&D costs are not related to the size of our force or the size of the inventory we intend to support. The cost of developing a new weapons system is the same no matter how many of that system we intend to produce. If we don't do

the R&D for a new system, then the number of systems of that type we will have is zero. It is not variable.

Third and finally, time is not a recoverable asset. It takes a certain amount of time to develop a new system, test it and put it into production. Time lost is, for the most part, not recoverable. By taking higher risks and accepting inefficiencies and higher costs, we can reduce the "time to market" of a new weapon system. This approach was used successfully to field Mine Resistant Ambush Protected Vehicles (MRAPs) for the conflicts in Iraq and Afghanistan; however, MRAPs are not complex cutting-edge weapon systems. Nominally, it takes about 10 to 15 years from conception until we have a modern complex system in the field in operationally meaningful numbers. Even during the 1940s we had to fight World War II largely with systems that were in development years before the war began. We can shorten, but not eliminate, the time required to field new cutting-edge weapons systems.

Fortunately the Department's leadership understands and supports these views. As Secretary Hagel made clear, we must strike a balance between our ability to meet current global requirements, maintain a trained and sustained force that can meet near-term needs and at the same time "protect the future" by continuing our highest priority R&D programs and the science and technology programs that feed them. The Secretary, senior leadership in the Office of the Secretary of Defense and in the Joint Staff and the Services all tried to strike the right balance as we built the Future Years Defense Program.

That brings me to our role in defense acquisition, technology and logistics. The efficiencies we continue working on under the Better Buying Power label are some of the tools we have to help sustain technological superiority. Every dollar of cost savings from a successful "should cost" initiative, every business deal we negotiate that provides better value to the government and every successful incentive structure we implement with industry will allow us to invest more in future technological superiority. We also have to become better at working with the operational requirements communities. By focusing on performance features that really matter militarily, this relationship helps ensure we provide the users with products that give them advantages they need at an affordable cost. Our technology base work also has to be strategically focused on areas that give us a significant operational advantage. Our responsibility in these still uncertain times, as always, is to deliver as much capability to the warfighter as we can with the resources entrusted to us. We will not sustain our technological superiority or "protect the future" unless we succeed.
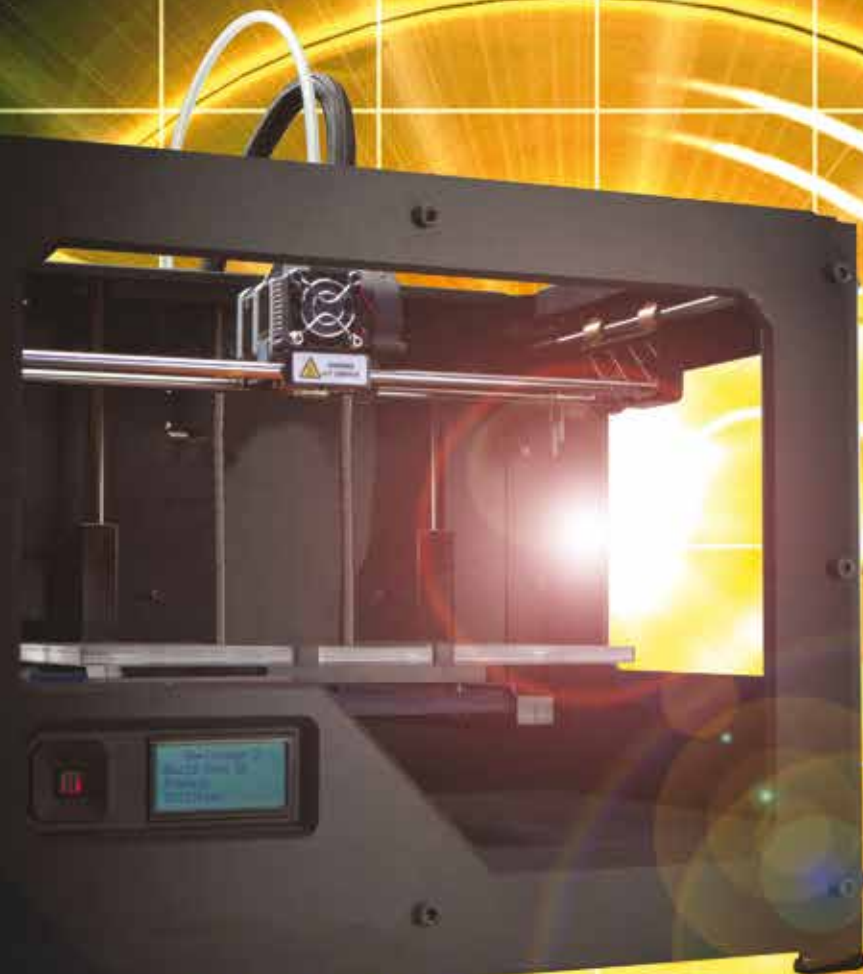
3D Printing

How Much Will It Improve the DoD Supply Chain of the Future?

Robin Brown
Jim Davis
Mark Dobson
Duane Mallicoat
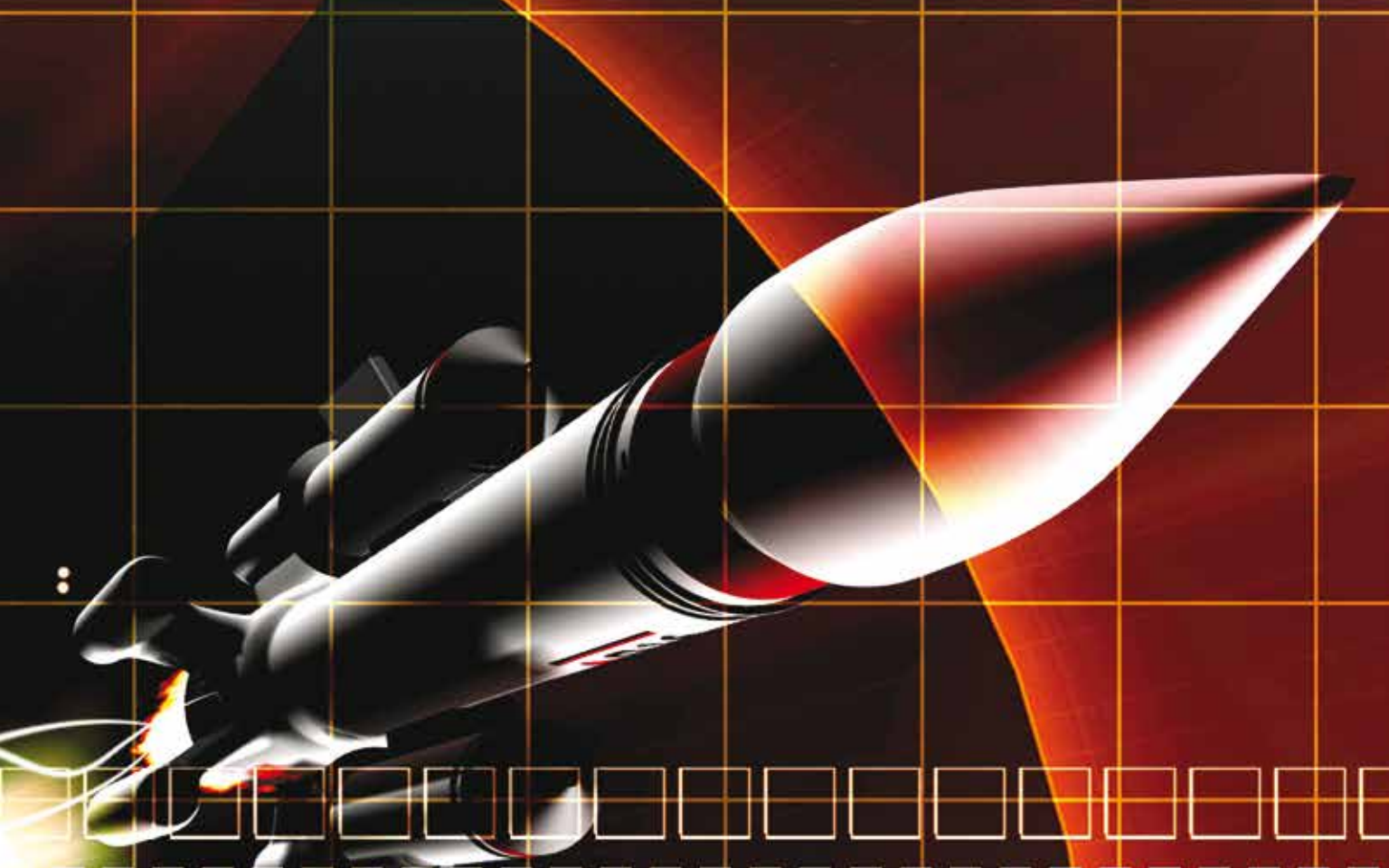
"C aptain's log, star date 2821.5. On route to Makus III with a cargo of medical supplies. Our course leads us past Murasaki 312, a quasar-like formation. Vague, undefined, a priceless opportunity for scientific investigation. On board is Galactic High Commissioner Ferris, overseeing the delivery of the medicines to Makus III."

Star Trek fans might recall these lines from the second episode of the original *Star Trek* television series that aired in 1966. The show, produced by Gene Roddenberry, challenged the audience with a string of science fiction technologies that many thought simply impossible. A handheld device that allows individuals to talk with each other over vast distances without the use of wires; an elevator that is voice activated; and a fan favorite, a machine (the replicator) capable of making any object that you need (including meals). Now this last technology is really over the top.

Those of us who live in the Department of Defense (DoD) supply chain management arena, however, are keenly aware that throughout the *Star Trek* series, there is never an appearance by the *Enterprise* supply officer. The absence of a supply officer may be a bit unnerving, but then again, *Star Trek* is science fiction and certainly not the harbinger for the end of supply officers and the supply chains they manage. There will always be storerooms filled with inventories and always a need for a supply officer or logistics officer who can master DoD's labyrinth of a supply chain. If history teaches us nothing else, it tells us that while there will always be a need for a supply chain, the chain itself will constantly be changing—consider it a state of evolution or, in some cases, revolution.

Throughout history, the ability to wage war has been rooted in a robust logistics operation. A key element to this logistics doctrine is the strength of the supply chain. Commanders who understood the importance of their

Brown *is the subject matter expert for diminishing manufacturing sources and material shortages within NAVAIR 6.7 at Patuxent River, Md.* **Davis** *is the Logistics Department chair and a life-cycle sustainment professor at the DAU Mid-Atlantic Region.* **Dobson** *is the product support manager for PMA-260 Common Support Equipment within NAVAIR 1.0 Acquisition Programs, NAVAIR Patuxent River, Md.* **Mallicoat** *is the associate dean of outreach and mission assistance for DAU Mid-Atlantic Region.*

supply chain were often successful, while those who ignored weaknesses in their chain were dealt devastating blows. From the days of Genghis Khan to the recent conflicts in Iraq and Afghanistan, the world has witnessed classic examples of successes and failures in logistics. This reference to history is critical to recognizing that the elementary concepts of supply chain management have been around for thousands of years. However, the tools and techniques used have changed dramatically over time, and we can expect nothing less in the future.

Current State of DoD's Supply Chain

As one might imagine, the present DoD supply chain is large and complex. For many, the sheer size and scope of the operation is beyond comprehension. There are myriad organizations, in both government and private industry, that are integral to DoD's supply chain. One organization that plays a pivotal role is the Defense Logistics Agency (DLA). DLA manages an inventory of more than 5 million line items with annual sales in excess of $44 billion. The inventory is warehoused throughout the world in more than 75 million square feet of storage space (the equivalent of nearly 1,300 football fields). In addition, DLA processes more than 100,000 requirements every day.

With budgetary pressures being applied across all of DoD, the supply chain becomes a target-rich environment for identifying efficiencies and reducing both the logistics footprint and overall costs. When we consider that in fiscal year 2012, DLA disposed of more than 2.5 million line items of material, it's easy to understand the desire for a more efficient chain. Finally, even with such a massive inventory, we still find ourselves with critical shortages of spare parts. Diminishing manufacturing sources and material shortages (DMSMS) is a thorn in the side for just about every weapon system, often leaving the warfighter frustrated with a multibillion-dollar supply chain that constantly faces challenges in trying to provide a time-sensitive "critical" component. All these factors in the current DoD supply chain naturally drive pressures towards greater and greater efficiencies.

By now you are thinking that the authors can't possibly be suggesting the elimination of supply depots and the millions of square feet of storerooms. Surely we can all take a little comfort in knowing that some things on *Star Trek*, such as the replicator, exist purely in the realm of science fiction. Nobody is crazy enough to be out there trying to invent such a machine—or have they already done so?

DoD Enters the 3D Printing Arena

First let's set the stage by defining 3D printing. To put it simply, 3D printing is a manufacturing process in which materials (plastic, metal or other) are laid down, layer by layer, to form a three-dimensional object. It is deemed an additive process where the object is built up from scratch, which is why 3D printing is also referred to as "additive manufacturing." This process is the opposite of the more traditional subtractive manufacturing process, where material is cut, drilled, milled

or machined off. 3D printers employ a variety of techniques and materials, but they share the ability to turn digital files containing 3D data—whether created on a computer-aided design (CAD) program or from a 3D scanner—into physical objects.

3D printing can be used to create models and prototypes quickly from CAD drawings, but lately they're increasingly used to make final products as well. The items made include shoe designs, furniture, wax castings for jewelry, tools, tripods, gift and novelty items, toys and, most recently, aviation engine components.

Riding the 3D Printing Wave

Some people in the industry think that additive manufacturing will overturn many of the economics of production, because the process pays no heed to unit labor or traditional economies of scale. Designs can be quickly changed because the technology enables flexible production and customization. Software can be used to predict exactly how a part will perform. General Electric is so positive about the capabilities of 3D printing that it is using the process to make jet engine parts. Morris Technologies (recently acquired by General Electric) uses a number of 3D printing machines in conjunction with a technology called laser sintering. This involves spreading a thin layer of metallic powder onto a build platform and then fusing the material with a laser beam. Laser sintering is capable of producing all kinds of metal parts, including components made from aerospace-grade titanium.

Meanwhile, Airbus partnered with the University of Exeter to open a 2.6 million euros Centre for Additive Layer Manufacturing in 2011. Its mission is to explore the 3D printing opportunities relating to aircraft. Their research goal is to investigate the production of a plane constructed entirely of 3D printed parts.

In the automotive industry, Ford showed off the latest version of its hybrid car at the Atlanta Auto Show in March 2013. The car's drive train, transmission, and other key parts were all produced using 3D technology.

The U.S. government has embarked on a $60 million project to form a 3D printing institute. The Air Force Research Laboratory is serving as the contracting agent for this DoD initiative. The ultimate goal is to help address warfighter requirements at the best value for the taxpayer while transitioning advanced manufacturing technology into the DoD and commercial supply chains.

All in all, these developments suggest a very promising future for a technology that has a great deal to offer. There is speed (design to production), flexibility, elimination of production run requirements (economies of scale), and what is sure to be far-reaching effects on transportation pipelines. Exactly what, however, does the average DoD weapon system program office gain from 3D printing, and how will 3D printing help make the program office product support manager's (PSM) job a little easier?

The PSM's View of 3D Printing

Even a cursory overview of the value that 3D printing technology would bring to the ever-demanding supply chain management profession would make any PSM giddy. Dozens of benefits instantly come to mind, but for now, let's look at just one.

One issue that causes significant consternation for the PSM—and presents a serious threat to mission accomplishment—is supply chain forecasting. In order to fully understand just what a game changer 3D printing could be, one must have a reasonable understanding of how the supply chain business is currently conducted. "Peeling back the onion" on supply chain forecasting reveals one very important driving factor to consider: funding. Of course, everyone understands that fiscal constraints play heavily in all DoD business decisions in today's environment. It is also safe to say that, in a risk-averse environment, all PSMs would love to have at least one of everything on the shelf, if cost were not an issue. Therein lies the PSM's dilemma: just exactly what parts are required on the shelf and, of even bigger concern, when will those parts be needed? Given that funding is a constraint, what demand signal does the PSM send to the supply chain to indicate which parts must be stocked on the shelf? The PSM will do the supportability analysis and with some confidence predict what spare parts should be required over a given period. However, let's say that during that predetermined period the supply system receives zero demand for a given part. Without being able to show demand, the system dries up and the chain cannot justify continued stocking or procurement actions for that part. Sure there are insurance items, and cases can be made to retain material, but holding material comes with a price, as all those who have taken basic business courses know. The trade-offs are simple. We must balance inventory holding costs with the risk associated with a stock out of a part that experiences little to no demand.

Unfortunately, as alluded to, the supply chain forecasting process is not 100 percent precise. Let us suppose that one day, say a couple of years after a certain part is no longer carried by the supply system, there is an urgent demand for that very part. At this point, the lead time to acquire the part can be between 12 and 18 months—or more! Why? In many cases, the process of acquiring the required part is back to square one. The supply chain must start performing market research, creating requests for information, developing a contract and a statement of work, specifying order quantities, negotiating with the prospective vendor and so forth. All this takes a great deal of time. Additional issues to consider are the lead time required for acquiring materials and the actual manufacturing of the part. Of course, this scenario doesn't even take into consideration the possibility that there may be DMSMS issues. This scenario plays out hundreds, if not thousands, of times a day throughout DoD.

Enter 3D printing. It may be hard to initially wrap your mind around the fact that all you need to produce a required part is a 3D printer, a 3D drawing of the part and the required materials (qualifying the specific part for use notwithstanding). Needless to say, this type of technology could cure a great many of the PSM's headaches. Just a few of the benefits include such things as nearly eliminating traditional contract actions, limiting the need for warehousing and storing inventory, and reducing the spending of precious resource dollars on surplus parts. Perhaps most important, however, 3D printing technology might be the answer to the PSM's greatest problem: diminishing manufacturing sources and material shortages (DMSMS).

It may be hard to initially wrap your mind around the fact that all you need to produce a required part is a 3D printer, a 3D drawing of the part and the required materials.

Is 3D Printing the Answer to DMSMS Challenges?

A DMSMS issue is the loss, or impending loss, of manufacturers or suppliers of items, raw materials or software. DoD loses a manufacturer or supplier when that manufacturer or supplier discontinues production of needed components or raw materials, or when the supply of raw material no longer is available. This can be caused by many factors that significantly affect the DoD supply chain and industrial base, such as low-volume market demand, new or evolving science or technology, detection limits, toxicity values, and regulations related to chemicals and materials. An old logistician's proverb—which begins with "for want of a nail the [horse] shoe was lost" and ends with the kingdom being lost "all for the want of a nail"—illustrates that the lowest level in a system's hierarchy can affect the entire system.

DMSMS challenges range from the introduction of counterfeit parts to shifting repair philosophies and an ever-faster product life cycle that is greatly influenced by the commercial sector. So, with all that said, perhaps instead of buying a part for inventory, we buy the rights to make our own on demand? Just think of all the benefits that could be realized from a "buy on demand" supply system philosophy. Surely it's not as simple as making your own parts in the back shop and completely eliminating DMSMS from our future vocabulary. There is a long list of issues that need to be addressed. Configuration management along with the ever elusive data rights issues are merely the tip of the iceberg when contemplating a "make your own part" supply system. But don't give up on 3D printing just yet. The challenges we face are not really any different than those arising from past technological innovations that shifted the DoD supply chain. Paradigms will shift, statutes and regulations will be revised, and the barriers and speed bumps limiting 3D printing will be resolved.

So Where Do We Go Next?

3D printing gives a whole new meaning to "Just in Time" supply chain management. But are we ready today to stop buying spares for our warehouse shelves and to sell off all of our warehouse real estate? The answer is obviously no. We hope, however, that this article has captured the reader's imagination about what we can start doing now in the world of 3D printing and how we must be proactive in the insertion of this technology into DoD's supply chain. There is a definite "ground swell" around 3D printing. Hardly a day goes by without reading about a new opportunity to leverage this technology. Here is a golden opportunity for the DoD acquisition community to come together with industry and make 3D printing a commonplace occurrence in DoD's supply chain. It will take a truly coordinated effort among all stakeholders for 3D printing really to take off. To quote Gene Roddenberry, "It isn't all over; everything has not been invented; the human adventure is just beginning."

The authors can be reached at **robin.y.brown@navy.mil**, **james.davis@dau.mil**, **mark.dobson@navy.mil** *and* **duane.mallicoat@dau.mil**.

Predicting Weapon Effects for Defense and Homeland Security

John Hendershot ■ *Robert Kaczmarek*
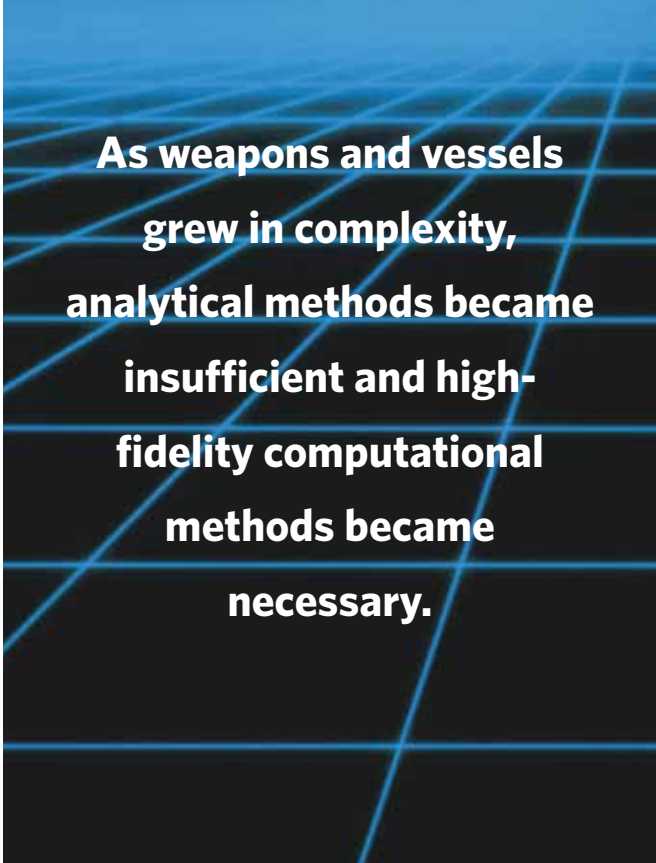
H ow well will weapons work? The answer to this question is not simple, but is necessary to develop effective weapons and survivable systems. The fundamental knowledge required to answer this question comes from energetics experts—researchers and developers of warheads, explosives, propellants and pyrotechnics. Ideally, real-world tests are used to determine weapons effects, but they are not always possible, particularly due to cost.

To improve this situation, the Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division (Indian Head), in Maryland, develops high-fidelity simulation tools to serve as an acceptable surrogate for real-world tests. These tools accelerate development and reduce cost, while informing weapons development and systems survivability for defense and homeland security applications. They provide the United States with a strategic advantage today and, with sustained investment, will continue to give the nation a strategic advantage for years to come.

The Quest for a Predictor
Underwater weapons are powerful assets in an arsenal. They can blow holes in a ship's hull, initiate violent whipping motions that can damage the ship and injure the crew, and, under the right circumstances, break

Hendershot *is director of the Energetics Technology Division and* **Kaczmarek** *is a member of the Technical Director staff at the Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division.*

> **As weapons and vessels grew in complexity, analytical methods became insufficient and high-fidelity computational methods became necessary.**

a ship completely in half. Understanding underwater weapons and their effects on targets is critical to U.S. naval superiority, aiding in naval weapons development, as well as in ship design and survivability assessments.

But understanding underwater explosions was long a vexing problem. During World War II, nearby torpedo explosions did more damage to ships than did direct hits. The reason for this was not well understood at the time. Following the war, theoretical developments helped researchers better understand underwater explosions and how ships and submarines respond to them. These theories helped improve undersea weapon lethality and led to more-survivable ship designs. As weapons and vessels grew in complexity, analytical methods became insufficient and high-fidelity computational methods became necessary.

In the late 1980s, undersea weapons researchers recognized the potential of modeling and simulation to aid in weapon design. The goal was to computationally assess new concepts in order to greatly reduce the amount of physical testing needed to field a weapon, thereby saving time, money and personnel.

Emerging computing power made this possible, but weapons effects software was needed. The U.S. Navy evaluated available commercial and government software capabilities. The most promising software was found in Germany. The Dynamic System Mechanics Advanced Simulation, or DYSMAS, software took an innovative approach to predicting underwater explosion effects and the response of naval targets. DYSMAS gained the U.S. Navy's attention, and in 1993, Germany provided the software to the United States for evaluation.

Initial evaluation led to three international project agreements focused on jointly enhancing and validating the software. All of the original software modules have been upgraded or replaced, resulting in a fast, modern software package that harnesses the power of the Department of Defense's largest supercomputers. The U.S.-German collaboration has focused on validating the software against real-world tests. Consequently, DYSMAS is now the most extensively validated full-physics software for predicting underwater explosions and their effects on marine structures.

The capabilities of DYSMAS for predicting weapons effects are not limited to naval applications. DYSMAS enjoys a wide user base spanning multiple government agencies, and it is solving real-world problems affecting sea war, land war and homeland security.

Predicting Weapons Effects from Ship to Shore

In the undersea domain, DYSMAS influences programs ranging from naval weapons development and effectiveness assessments to ship survivability and acquisition. As foreign navies advance their fleets and the geopolitical climate changes, U.S. strategy for naval conflict evolves, and with it the requirements of naval weapons. DYSMAS affects naval weapons development programs throughout the design, assessment and acquisition process.

A major use of DYSMAS is for assessments of undersea warhead lethality against targets such as ships, submarines, torpedoes and mines. For example, DYSMAS was used to optimize the warhead configuration for the Countermeasure, Anti-Torpedo (CAT) System that will be fielded to defend high-value platforms from incoming enemy torpedoes. After the *USS Cole* attack, DYSMAS was used to support the development of weapon concepts to engage and destroy swarms of small boats, a very real threat scenario in the Persian Gulf. DYSMAS currently is being used to assess warhead concepts for next-generation Anti-Submarine Warfare torpedoes, especially in the context of small warheads that can be launched from the air or from undersea autonomous vehicles.

DYSMAS supports amphibious warfare and mine countermeasure programs. It predicted the ballistic penetration of air-released darts through water and sand, determining their ability to neutralize mines in the surf zone. To help Marines prepare for amphibious landings, DYSMAS was used to assess the effectiveness of air-dropped explosive ordnance for obstacle clearance, calculating the trajectories of anti-access obstacles in response to bomb blasts. It currently is being used to assess the vulnerability of moored contact mines to explosions, supporting development of a new mine-countermeasure system.

Another major use of DYSMAS is the protection of U.S. naval forces. Underwater threats to U.S. forces are increasing continuously. Foreign defense contractors estimate that foreign

Above: Indian Head personnel measure the diameter of a blast crater from a replicated IED.
Right: This screenshot from a computer simulation graphs the extent of a blast crater.
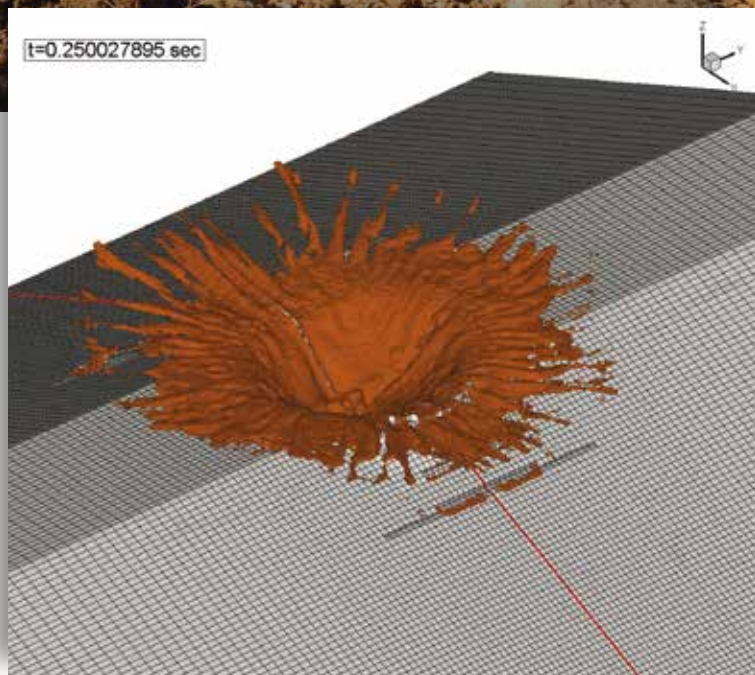
torpedo effectiveness has doubled in the past decade, largely due to Russian research and development. Furthermore, 60 foreign navies possess an estimated 1 million sea mines, with more than 300 types; some look like rocks, making them hard to find, and some move, making them hard to neutralize.

DYSMAS is used to assess the vulnerability of new ship designs, including the littoral combat ships and the Zumwalt-class guided missile destroyer, to underwater weapons and to develop protective technologies to improve survivability. It is especially important for new ship missions that require operations in relatively shallow waters, where mines on or near the sea bottom can have additional damaging effects due to the complex blast interaction with the sea bottom. DYSMAS simulations are also improving the design of external structures on vessels to ensure that they are resistant to explosion effects—a concern with increasing numbers of unmanned systems, delivery vehicles and special operations containers.

The full potential of DYSMAS in naval systems development is still being explored. There is potential for DYSMAS to aid in the maturation of ship design beyond the well-established paradigm of using historical data, experimental testing and redesign before the construction process. This capability is being explored for ship survivability applications under the Computational Research & Engineering Acquisition Tools & Environments (CREATE) program sponsored by the Department of Defense High Performance Computing Modernization Office. The CREATE program leverages DYSMAS for the blast physics, fluid dynamics and unique fluid-structure interaction-coupling technology, and leverages the Department of Energy's structural solver codes that have been enhanced for Navy ship-design applications.

Predicting Weapons Effects in Land War

In Iraq, the Marines encountered urban combat that required a novel solution. Insurgent-held buildings were dangerous and difficult to clear, so a portable standoff weapon

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Computer simulations reduce the need to conduct real-world tests of explosives, saving money and lessening the environmental impact.

capable of defeating these targets was requested. Indian Head researchers assisted in development of the "novel explosive," or NE, warhead for the Shoulder-launched Multipurpose Assault Weapon (SMAW). The NE warhead produces pressures capable of leveling the intended target. DYSMAS was used to analyze the mechanical behavior of the warhead during penetration, leading to important fuze design modifications.

The punishing effects of improvised explosive devices (IEDs) used against U.S. forces in Iraq and Afghanistan are well documented. Mitigating the IED threat was critical, but the IED signature in Afghanistan differed from that encountered in Iraq. Those in Afghanistan typically use fertilizer-based "homemade" explosives, or HMEs. Researchers at Indian Head performed tests to quantify HME explosion output and provided the data required to develop a computational model of the HME. Once developed, the HME model was validated by both Indian Head and Army researchers for use in DYSMAS and other software packages.

Despite an in-depth understanding of IEDs, efforts to detect IEDs before detonation, and the development of under-body kits and blast-mitigating seats, IED blasts continue to be a major source of casualties today. Better

solutions are needed, and modeling and simulation continues to play an important role in the development and assessment process.

In collaboration with Army and Navy researchers, the DYSMAS team is supporting this work. DYSMAS is being enhanced to do a better job of modeling soils and the loading that a buried blast transmits to a vehicle and its occupants—a difficult and complex problem given the wide range of soils and emplacement conditions that must be considered. DYSMAS also has been used to assess mine-rollers for Marine Corps vehicles and, recently, to study blast-induced traumatic brain injury. The goal is to understand the biomechanical response of the brain, enabling the development of protective technologies.

Predicting Weapons Effects to Protect the Homeland

Dams are designated as critical infrastructure in the United States. They are important national assets that provide water, power and flood-control to many Americans; but dams also hold back tremendous amounts of potential energy that, if released, can have devastating consequences. It is reported that terrorists and criminal organizations have targeted dams for attack.

To assist in addressing these threats, Indian Head researchers are collaborating with other government agencies to assess the vulnerability of dams to terrorist attack and to develop mitigation technologies. DYSMAS is the tool of choice for these studies, which include cratering of earthen dams and blast effects against arch dams and spillway gates.

DYSMAS has been useful in assessing other critical infrastructure, including that found in and around harbors and other waterways. Many pipelines, carrying energy supplies such as oil and gas, transit harbors and waterways on the sea floor. A major problem for explosive ordnance disposal (EOD) operations lies in assessing the risk to such assets when threats are found. DYSMAS has supported the EOD mission by analyzing the hazards to pipelines and enabling the development of safe standoff guidance for EOD operations. In related studies, DYSMAS has been used to assess the vulnerability of bridges and dry docks to explosions.
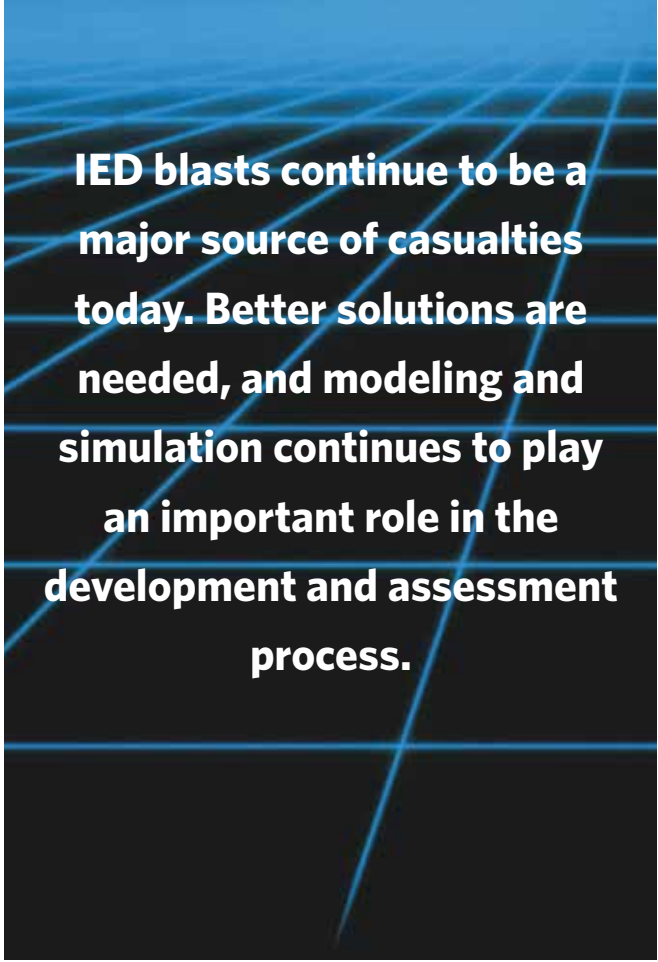
The Need, the Future

DYSMAS is a powerful tool for computing the effects of weapons—from torpedoes to IEDs—on a variety of structures—from ships to dams. The DYSMAS predictive capability is a unique asset within the Department of Defense. It provides the United States a strategic advantage on the battlefield and allows for the protection of citizens and infrastructure at home, preserving lives and the American way of life.

To retain this advantage the Navy should maintain a robust investment in the development, enhancement and support of DYSMAS. "By 2025, precision-guided weapons will be the norm among our adversaries," stated Chief of Naval Operations Admiral Jonathan W. Greenert in a 2011 U.S. Naval Institute publication. Naval weapons will likely include smart mines, super-cavitating torpedoes, armed unmanned systems and more. If these assertions are correct, weapons will become smarter, faster and more autonomous. The need to assess the effectiveness of future weapons will only increase. This need is equally important for homeland security. Domestic terror threats are real, and the need to understand infrastructure vulnerability remains a critical requirement.

In this age of dwindling budgets and environmental concerns, modeling and simulation will only grow as a critical part of this process. Testing is necessary, but is often expensive and can be harmful to the environment. Echoing the original goal from the 1980s, the objective will be to computationally assess systems in order to greatly reduce the physical testing needed—saving time, money, personnel and the environment.

This means investing in methods development while supporting users and pushing forward software validation. As this article is written, the United States and Germany are finalizing a fourth international project agreement to continue software development and validation. Strong collaborations have been established with U.S. Army and homeland security

IED blasts continue to be a major source of casualties today. Better solutions are needed, and modeling and simulation continues to play an important role in the development and assessment process.

programs. DYSMAS currently supports 170 users throughout the United States, and that cadre is growing as new applications are added.

Today, DYSMAS stands as the most extensively validated modeling and simulation tool for predicting the effects of undersea weapons on naval platforms. Pushing beyond the undersea boundary, it has found successful application in air-blast, buried-blast and even traumatic brain-injury applications. It affects the defense research, development and acquisition communities, as well as the homeland security community. In the future, it can also inform the intelligence and targeting communities, by helping analysts understand threats, and even contribute to manuals on joint munitions effectiveness, by informing targeteers and weapons operators.

The DYSMAS team is supporting the programs of today and pushing forward the technology development and validation that will make the programs of tomorrow successful. In DYSMAS, the United States has a government-owned modeling and simulation tool that is unique and critical to the nation's defense. It is itself a piece of critical technology that provides a strategic advantage today and, with sustained investment, will continue to give the United States a strategic advantage for years to come.

The authors can be contacted at **john.hendershot@navy.mil** *and* **robert.kaczmarek@navy.mil**.

Integrated Cost Analysis Teams

How ICATs Support Better Buying Power 2.0

Jason B. Newman

J ohn DelGreco starts each morning at 0600 at the Defense Contract Management Agency (DCMA) Raytheon Tewksbury Contract Management Office (CMO). He's been doing it a while. January 2014 represented the start of his 27th year as a contract price/cost analyst at DCMA. Over the course of his career, he has seen many changes within the agency and the pricing career field.

In the early 1990s, with mandatory personnel reductions, the pricing function began its slow move away from DCMA and toward the buying commands. When DelGreco first started at DCMA, 12 price/cost analysts and six cost monitors assigned to the CMO were performing pricing work. By 2008, only two price/cost analysts remained at the CMO. In April 2009, however, this was all set to change as Ashton Carter was appointed the Under Secretary of Defense for Acquisition, Technology and Logistics.

Affordability to the Forefront

In June 2010, Carter released a memorandum for all acquisition professionals, titled "Better Buying Power: Mandate for Restoring Affordability and Productivity in Defense Spending." He articulated a vision of program affordability by targeting unneeded programs and activities, as well as the goal of "delivering better value to the taxpayer and improving the way the Department does business." One of the ways to accomplish this was to place greater emphasis on pricing at the major defense contractors. This core capability had become lost with all of the downsizing and reorganization within the Department of Defense (DoD). Pricing analysis at the major defense contractors became one of his highest priorities, and he wanted to reform the way the Pentagon bought goods and services. Coupled with a dynamic political environment, affordability became the axiom and even more critical to DoD's future success.
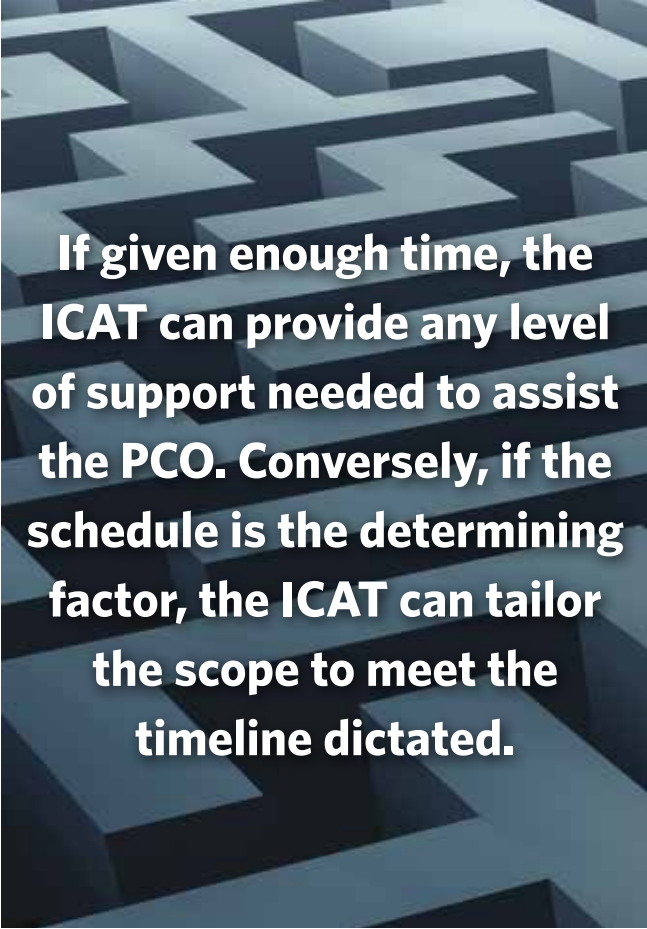
The Budget Crunch

As the DoD focused on making acquisitions more affordable, political realities intensified that need. In August 2011, President Obama signed into law the Budget Control

Newman *is the ICAT director at Defense Contract Management Agency's Raytheon Tewksbury office, and a retired U.S. Air Force major.*

> **If given enough time, the ICAT can provide any level of support needed to assist the PCO. Conversely, if the schedule is the determining factor, the ICAT can tailor the scope to meet the timeline dictated.**

Act, creating the Joint Select Committee on Deficit Reduction. By design, this committee was responsible for producing deficit reduction legislation. If it failed, the law would trigger automatic spending cuts called "sequestration." The intent of the legislation was to act as an enforcement mechanism. If the committee failed to reach an agreement, the automatic spending cuts would go into effect. That is exactly what happened. No agreement was reached by the deadline, and the automatic cuts went into effect (after an initial delay) in March 2013. The DoD was hit with half of the required cuts in discretionary spending. Its share of the bill was approximately $980 billion over the next 10 years.

DCMA Response
In 2011, Shay Assad became director of defense pricing and set out to fulfill Carter's articulated "affordability" vision. He instructed DCMA to begin a restructuring focused on providing better pricing capability for the DoD. What was his stated goal? "DCMA should know more about the contractor's proposals and business systems than the contractor." This was DCMA's opportunity to level the playing field when it came to negotiations.

DCMA wanted to create a dedicated cadre of personnel focused on specific work, including rates, indirect costs, cost monitoring, cost accounting standards/disclosure statements and other items. The solution was to align the divisional administrative contracting officers (DACOs) and cost monitors from the CMOs with the Cost and Pricing Center corporate

administrative contracting officer (CACO). Besides aligning them within the same reporting chain, this action lined up the CACO and DACO work on a corporate structure basis and created consistency for all companies across their different business segments. The next step in embodying the affordability mandate was establishment of the integrated cost analysis teams (ICATs) at the major defense contractors.

Establishing the ICATs
The plan set four criteria for the ICAT implementation. First, the selected contractor locations had to have more than $3 billion in the general-and-administration business base. Second, there had to be an existing, in-plant DCMA presence. Third, a DACO was required on site. Fourth, there had to be significant current, or potential, pricing work. Based on these criteria, a total of 10 ICATs were established (eight in 2012 and two in 2013). The companies and locations were Bell Helicopter, Boeing St. Louis, Boeing Philadelphia, General Electric Evendale, Lockheed Martin Fort Worth, Lockheed Martin/United Launch Alliance Denver, Northrop Grumman/General Atomics Redondo Beach, Raytheon Tucson, Sikorsky Stratford and Raytheon Tewksbury.

According to the ICAT vision statement, the ICATs aim "to be the leading experts in complete proposal analysis, enabling our partners to achieve contract objectives." The specific purposes of the ICAT are to (1) provide complete proposal analysis, (2) support customer proposal negotiations and (3) perform continuous evaluation of the contractor's estimating system.

Proposal Analysis
The ICAT is composed of technical experts and business advisors who perform in-depth, integrated price and technical reviews and analysis of the contractor's cost/price proposals. The objective is to provide the customer and its procuring contracting officer (PCO) with a supportable and sustainable starting position for negotiation.

The ICAT can deliver full pricing and technical analysis on any proposal or contract; however, the primary emphasis for ICATs is support for major proposals ($250 million and above). The Defense Federal Acquisition Regulation Supplement (DFARS) audit thresholds ($10 million for fixed contract types and $100 million for cost type contracts) play an integral role in coordination efforts with Defense Contracting Audit Agency (DCAA). While the expectation is that DCAA will perform an audit on the proposals over the DFARS threshold, the ICATs perform technical analysis and assess the rate recommendations on those proposals as well, arming the PCO with an all-encompassing report.

Requesting DCMA assistance is straightforward. The customer receives a proposal in response to a request for proposal and then submits a request to the cognizant DCMA administrative contracting officer (ACO) asking for field pricing/technical support for their negotiations. The ACO then coordinates with the ICAT, and analysis begins.

Table 1. ICAT: DCMA Lines of Service Supporting Better Buying Power 2.0

BETTER BUYING POWER INITIATIVE: ACHIEVE AFFORDABLE PROGRAMS

DCMA Lines of Service: Cost and Pricing Services

Support Negotiations
- Real-time model updating
- Complete customer engagement
- Supportable/sustainable input
- Unprecedented contractor insight

Review Proposals
- Review material/labor hours
- Analyze historical data
- Coordinate audit assists
- Assess subcontractor performance
- Verify rates
- Tailor-made to fit user needs

BETTER BUYING POWER INITIATIVE: ELIMINATE UNPRODUCTIVE PROCESSES AND BUREAUCRACY

DCMA Lines of Service: Major Program Support

Reduce Cycle Times
- Targeted 45 days or less turnaround
- Simplified notification through ACO
- Prompt acknowledgment process
- Reduced outside dependency
- Self-sustaining organization

Reduce Overhead
- Streamlined peer-review process
- Comprehensive internal quality review
- Direct ICAT-to-customer product dissemination

BETTER BUYING POWER INITIATIVE: CONTROL COSTS THROUGHOUT PRODUCT LIFE CYCLE

DCMA Lines of Service: Contractor System Reviews

Evaluate Business Systems
- Review contractor business practices
- Validate cost-estimating relationships
- Assess accounting systems

Support Divisional ACO
- Supplement cost-monitoring activities
- Evaluate cost reduction initiatives
- Perform disclosure reviews
- Analyze pricing rate agreements
- Perform independent research and development analysis

BETTER BUYING POWER INITIATIVE: INCENTIVIZE PRODUCTIVITY AND INNOVATION

DCMA Lines of Service: Major Program Support

Support DCAA
- Perform technical analysis on all DCAA audits
  — Primary emphasis on major proposals (> $250 million)
  — Arm PCO with all-encompassing report
- Perform technical review of progress payments

Engage Contractor
- Participate in contractor cost-estimating manual revision
- Review management of subcontractors
- Evaluate supplier proposals

The goal is to provide the government negotiator the best proposal analysis based on the customer's requirements. If given enough time, the ICAT can provide any level of support needed to assist the PCO. Conversely, if the schedule is the determining factor, the ICAT can tailor the scope to meet the timeline dictated.

Support for Customer Proposal Negotiations

The proposal analysis the ICAT provides establishes a "supportable" negotiation starting point. However, the ICAT's charter doesn't end when the analysis is done. Another primary focus is to provide the PCO and customer with a "partner at the negotiation table." The ICATs are designed and staffed to directly support negotiations.

ICATs have a unique insight beneficial to government negotiations. Unlike other members of the System Program Office integrated product team, the ICAT has immediate, on-site, contractor access. The team can review contractor financial, supply chain and estimating systems for actual costs and labor

hours. The team can verify that the ICAT proposal analysis performed is supportable and sustainable. The ICAT can further enhance negotiations by delivering real-time cost-modeling updates as the talks progress.

Ultimately, the goal is to put the government negotiators in the best position to get the warfighters what they need—on time and on cost. Both proposal analysis and negotiation support represent how the ICAT can directly benefit the PCO or customer.

Continuous Evaluation of Contractor's Estimating System

As part of the annual DACO support, the ICAT is charged with several overarching requirements that affect multiple proposals. Here are some examples:

- Incorporate cost-estimating relationships (CER) reviews into every analysis. A CER is a mathematical equation in which a cost is expressed as a dependent variable of one
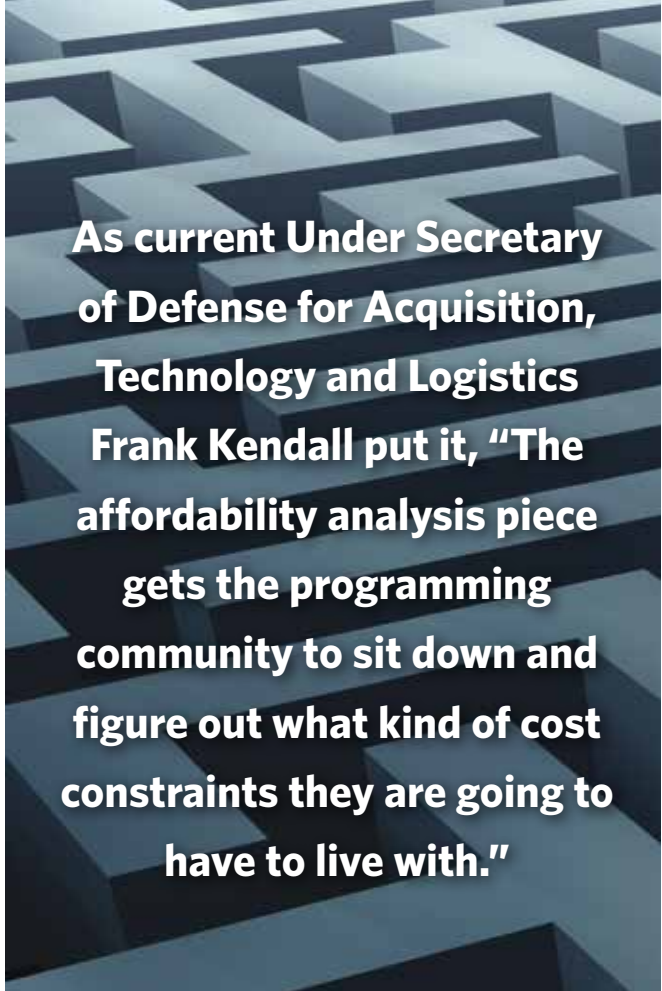
or more independent variables. The ICAT analysis ensures that the equation's underlying data is accurate, applicable and current.

- Review of the contractor's independent research and development (IR&D) efforts. The IR&D is a company expense for future research efforts. The ICAT certifies that the projects have a valid government benefit, are appropriately categorized, and are compliant with DFARS 231.205-18.
- Evaluate and assess the value, implementation and potential savings of contractor-proposed cost reduction initiatives through monitoring and tracking.
- Develop and maintain historical data on negotiated and actual costs to execute the business base review for forward-pricing rate proposals.

Table 1 summarizes the DCMA lines of service that ICATs provide in support of Better Buying Power 2.0. The bottom line is that ICATs seek to control costs throughout the product life cycle by providing expert proposal analysis, supporting negotiations and continuously evaluating the contractor's estimating system.

Going Forward

The mandate for affordable programs will not be going away anytime soon. As shrinking budgets continue to be stretched across more and more programs, the emphasis to find savings at all levels will dominate the conversation. As current Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall put it, "The affordability analysis piece

As current Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall put it, "The affordability analysis piece gets the programming community to sit down and figure out what kind of cost constraints they are going to have to live with."

gets the programming community to sit down and figure out what kind of cost constraints they are going to have to live with." DCMA will continue to emphasize its renewed focus on improved technical and pricing capability to support the Better Buying Power 2.0 and Affordability initiatives. The ICAT is the embodiment of that improved support.

Charlie Williams, former DCMA director, stated,

> Nothing the department is doing today in the procurement and acquisition business has as much focus as support for the affordability initiative. The re-building of DCMA's pricing capability is at the heart of our support to this initiative. The stand-up of these ICATs ensures expert pricing assistance is available to support the Department's major defense program teams and decision makers.

As John DelGreco prepares to leave for the day, he realizes that change is still coming, but the focus has shifted. He is now part of the Raytheon Tewksbury ICAT. For him, history has come full circle. The ICAT now consists of seven engineers and eight price analysts with a wide range of experience. This entire team is dedicated to providing the needed proposal pricing and technical support. It is the physical embodiment of DCMA's vision to support the Better Buying Power 2.0 and Affordability initiatives.

The author can be contacted at **jason.newman@dcma.mil**.

MDAP/MAIS Program Manager Changes

With the assistance of the Office of the Secretary of Defense, *Defense AT&L* magazine publishes the names of incoming and outgoing program managers for major defense acquisition programs (MDAPs) and major automated information system (MAIS) programs. This announcement lists all such changes of leadership for both civilian and military program managers that occurred in recent months.

Navy/Marine Corps
Capt. William McNeal (USN) relieved **Capt. Didier Legoff** (USN) as program manager for the Tactical Networks Programs (PMW 160) on Nov. 1.

Capt. Jaime Engdahl (USN) relieved **Capt. Carl Chebi** (USN) as program manager for the Precision Strike Weapons Programs (PMA 201) on Dec. 16.

Capt. John Bailey (USN) relieved **Capt. John Green** (USN) as program manager for the Next Generation Jammer Program (PMA 234) on Jan. 24.

A Chance to "Alpha-Innovate" in Program Management

Lt. Col. Ann Wong, USAF

The Department of Defense (DoD) continues to look for ways to encourage innovation and the transition of innovative concepts into its programs. The federal government has continued to support DoD rapid acquisition programs to get great ideas out to the warfighter. For example, the Air Force Research Laboratory's Vehicle Stopper Challenge encourages hopeful innovators to solve a specific problem. Similarly, the government website Challenge.gov offers prizes to people who can help solve technical problems in a wide variety of government programs.

While attracting innovation through programs like these is extremely valuable and provides great exposure, what can be done to improve the overall DoD acquisition process? What changes can be made within the infrastructure that will encourage innovation in all programs?

The new interim DoD Instruction (DoDI) 5000.2, dated Nov. 26, 2013, formally calls for the program manager (PM) and program office (PO) to be established during the first phase in the acquisition life cycle, the Material

Wong *is a professor of systems engineering at the Defense Acquisition University. She is certified DAWIA Level III in Engineering, Science and Technology Management and Program Management.*

Solution Analysis (MSA) Phase. The designation of the PM at the nascent phase of a program gives the DoD an unprecedented opportunity to bridge the science and technology (S&T) "valley of death" and open the door to encouraging more innovation in DoD programs. Call it "alpha-innovating" from the DoD PM perspective.

Let's take a look at a prominent trend—"alpha contracting"—adopted by various parts of the DoD to address their priority concerns. The medical community promotes preventative care to increase the success of patient care by encouraging patients to maintain their health and catch medical problems early. Similarly, the contracting community adopted alpha contracting, according to Acquipedia, in order to improve the typically lengthy contracting process by enhancing communications, decreasing the number of formal proposal requests and the revisions required to correct errors, and reducing the whole process time (procurement administrative lead time) needed for contracting. Most recently, Steven Hutchison, former principal deputy in the Office of the Deputy Assistant Secretary of Defense for Developmental Test and Evaluation (DASD[DT&E]), introduced the "Shift Left" focus area in the DASD(DT&E)'s fiscal year 2013 Annual Report, calling for the test community to increase its involvement during the earlier phases of the acquisition life cycle.

What all of these communities have in common is the recognition that early involvement has attractive payoffs in the long term.

This article proposes several roles and responsibilities for newly appointed PMs that take advantage of the change in the DoDI 5000.2 policy. The article also identifies several institutional changes to help new PMs with their innovation goals.

New Roles and Responsibilities

Outreach Agent. During the early stages of gearing up for an Analysis of Alternatives (AoA), the DoD canvasses industry for their good ideas by a "request for information" call on the Federal Business Opportunities (FBO) website. This exchange is important. It tells industry that DoD has prioritized a certain set of capability gaps and is taking the next step in potentially closing those gaps. It helps answer industry's question, "What does the DoD want to invest in?" However, before the recent DoDI 5000.2 update, there has not been a requirement for a formalized point of contact for the pending program—someone who has a strong long-term interest in continuing the conversation with industry.

Designating the PM and establishing the PO during MSA allows the PM to be an active part of a program's innovation outlook from the very beginning. It enables PMs and industry to engage earlier than ever before, an especially valuable change as the AoA identifies the program's critical technology elements. Specifically, the DoDI 5000.2 states, "To achieve the best possible system solution, emphasis shall be placed on innovation and competition." Tools like

the Defense Innovation Marketplace (www.defenseinnovationmarketplace.mil), as instituted by the Better Buying Power practice to "expand programs to leverage industry's IR&D" (independent research and development), give PMs insight into industry's IR&D efforts as never before. A major PM priority becomes engaging with industry to help guide its IR&D investments. As a result, industry gains the lead time to decide how it wants to invest IR&D funds and plan ahead for the Technology Maturation/Risk Reduction Phase.

Innovation Detective. In the MSA Phase A, a PM has more time to look across the innovation landscape to investigate, encourage and incorporate innovative ideas. This landscape includes technology transition programs within the DoD—such as Joint Capability Technology Demonstrations, Small Business Innovative Research and Title III for Defense Production—as well as Service-specific or other governmental transition programs. In addition, the PM has opportunities to canvass commercial (non-Defense) industries that may have applicable technologies.

Innovation Bridge-builder. The PM has earlier involvement in ensuring successful technology transition, crossing that "valley of death." The science and technology (S&T) community—including laboratories, federally funded research and development centers and university-affiliated research centers—relies on both the warfighter and the program management communities to ensure a successful technology transition. The S&T community teams with the warfighter community to understand the requirements and confirm its technology's relevance while researching and developing its advanced technology, and it teams with POs to transition its technologies to the warfighter. These technology transitions are formalized through technology transition agreements, which are usually signed by the S&T lead and the PM.

Before the latest DoDI 5000.2 update, there was generally not a formalized PO focal point for the S&T community to work with on such transitions. There are several organizations, such as the Air Force's product centers' developmental planning organizations, that can guide a transition to a point, but, at the end, PMs are still a critical element to the transition, as they own the program. Prior to this DoD 5000.2 update, PMs were not formalized until Milestone (MS) B for new programs. At this point, a program's critical technology elements should already have been assessed at technology readiness level 6, the PM has an acquisition program baseline and other marching orders in hand, and the window of opportunity and flexibility to incorporate additional potential innovations decreases. A PM who is designated early in the process can take on the role of strategically shepherding the technology transition toward the program's end state.

Long-term Program Architect. The PM leads the efforts to publish a program roadmap. This roadmap is a long-term look at how the program and any supporting programs will fulfill the warfighters' needs. For the innovation-savvy PM,

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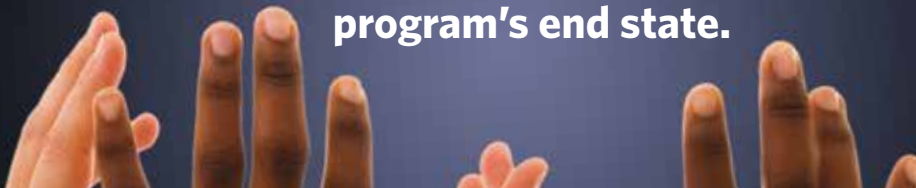
writing the roadmap in the MSA allows that PM to institute his or her vision for the next 10 to 15 years. The PM's vision should include engagement strategy with industry, the S&T community and applicable government agencies. While capturing the program's technology forecast, the PM should record technology pathways, how those technologies will on-ramp to the program and how unsuccessful technologies will be off-ramped. A roadmap that intrinsically includes the desire to explore and insert technological innovations also allows the staff to develop its contract strategy in the long term, which could maximize benefits to the acquisition and warfighter communities.

Risk Taker. The PM ultimately owns the risk management program in the PO and sets the tone for the risk culture within the organization. While risk is inherent in any development program, the risk increases as the PM tries to travel more innovative paths. While a formal acquisition PO doesn't have the same capacity to take risks as does the Defense Advanced Research Projects Agency (DARPA), the PM makes strategic, contractual and cultural decisions to foster a culture that will allow more risk taking. Strategically, the PM may design more technology on-ramps and off-ramps into the program plan. The PM's contracting strategy may focus more on risk sharing and how to incentivize industry innovation. Culturally, PMs can influence their staffs with their vision from the kick-off of the PO and with each subsequent hiring action. As Dr. Arati Prabhakar, director of DARPA, explains in a profile by Amanda Davis for the IEEE newsletter (Jan. 7, 2013):

> It all starts with the project managers. They have to listen and gather information, identify the problems keeping people up at night, find out what's brewing in their technical area, run with a certain idea, and then rally the technical community around a common goal.

The PM can set these decisions in motion from the start of the program life cycle, building a welcoming environment for seeking and incorporating innovative technologies from the ground up, instead of dealing with an "inherited culture" at MS B.

Innovation Ambassador. A critical role of PMs is to engage their communities, garner support for the programs and develop relationships with stakeholders on behalf of their programs. This span of personalities includes folks within and outside the PO. PMs who support an innovative culture and are

trying to push boundaries may face resistance and pressures to conduct a lower-risk program. PMs may find they need to fill an educational role (and, at worst, a defensive one). How do PMs fulfill the educational role? First, they must understand the fundamentals of cultivating and maintaining a creative and innovative culture. Several short lectures by experts in the field, such as educator Sir Ken Robinson, writer Steve Johnson or IDEO founder David Kelley, are available on free-access media on TEDTalks (www.ted.com). Scholarly papers published by such authors as Harvard Business School Professor Teresa M. Amabile also are helpful. PMs who understand and internalize these fundamentals are better equipped to incorporate these principles into their program and to socialize their vision. They must "walk the walk" and, what is more important as an ambassador, "talk the talk."

With the PM designation and program initiation occurring in MSA, the PMs' window increases for weaving these fundamentals into the basis of their planning and strategy. In MSA, PMs will be working their program's first program objectives memorandum (POM) inputs through their Service or agency leadership. This POM input becomes the first quantitative instantiation of the acquisition strategy and related risks, and how the innovation-friendly strategy is socialized and justified becomes a critical challenge.

Other "ambassadorial" opportunities exist. For example, PMs may promote innovation when supporting their Service for any programmatic discussions at a congressional level, or when conducting "industry days" and sharing ideas with other PMs.

Institutional Changes
The foregoing roles and responsibilities are not the only changes needed. The DoD acquisition process doesn't revolve around one position. There are several other areas that may need to change in order to help the PM morph into the innovation agent the program needs.

Staffing with Innovators. Staffing needs can be put in two categories: functional and personal traits. Keeping in mind that the PO is being initiated in the MSA Phase, the PO should have functional representation from the S&T community and serve as liaison to industry and to other government agencies. With respect to personal traits, the PO needs folks who understand and are open-minded about blending innovation

into the program strategy. They need to be innovative thinkers themselves and be willing to openly engage with industry (defense and non-defense), the S&T community at large and other government agencies. The PM should be a visionary but disciplined leader. Whereas the S&T community has the charge to do research to increase knowledge, PMs must remember that they do not and must not hobby shop. PMs should have a belief in the value of bringing emerging technology to the warfighter, and they must be able to execute a program efficiently to meet warfighter needs. Innovation is not just building new things but building and delivering that capability to the warfighter.

PMs Must Be Incentivized. The basic report card of a traditional PM depends on management of cost and schedule deadlines, performance of the system and mitigation of risks. This evaluation doesn't give the PM much incentive to incorporate many on- and off-ramps for innovative ideas in the program. One incentive would be to track return-on-investment for transitioned technologies and give the PM credit, just as PMs are given credit for cost savings/avoidance. One possible way to measure the level of innovativeness could be to borrow from an accounting principle, the "price-to-innovation-adjusted earnings" measure. Per the Investopedia website,

> Companies in [certain] industries are pressured by the need to innovate. However, accounting principles hurt these companies by forcing them to deduct R&D spending from earnings. Heavy expenditures on R&D [show] that a company is willing to take risks to further its growth. This calculation allows an investor to identify these innovative companies.

While this would take some research to translate to the DoD business model, it should be possible to establish a helpful measure.

Shift of R&D Funding. Allow PMs to own some 6.1, 6.2 and 6.3 funds to use as research grant funding. This funding shift serves two purposes. First, because PMs have this funding, looking proactively into the S&T arena becomes part of their portfolio (the grant aspect). Second, during technology transition, the resource reduces the funding impediment in the "valley of death." Should PMs own all the S&T funding? *Absolutely not*. R&D expertise belongs in the S&T community, which should still maintain its own total obligation authority.

However, with funding comes the responsibility to understand its use, and this may be a good glue to draw the PM and S&T community closer.

Spread the Word. The DoD is making strides with the deployment of their Defense Innovation Marketplace website. Another way to continue to keep industry in the know would be to post on the site a list of ongoing and upcoming AoAs. Ensure that all the opportunities are listed with the point of contact and link to FBO. Though AoAs and requests for information are not exactly IR&D areas, raising the awareness of DoD activities would be advantageous and bring additional traffic and exposure to the site.

Shift the Culture. DoD as a whole must embrace the culture that allows creative engineering to become successful innovation. Acquirers must resolve to allow more risk taking, but ensure the acquisition strategy has the teeth to balance between innovation and delivering capability to the warfighter on time. The new DoDI 5000.2 designates the PM during MSA, facilitating the culture change during the birth of the program rather than midway at the Engineering and Manufacturing Development Phase. This PM appointment opens the time window immensely. PMs must embrace those vendor engagements, so that the mentality that says, "Hey, I don't have time to meet with vendor X, I have a program to run," now flips to encourage such engagements because of a desire to look for those innovation opportunities.

Conclusion

Like the medical, contracting and testing communities, the PM community now has an opportunity to engage up front and early. They can engage with industry earlier, bring the R&D community closer and stay more connected with both as the program matures. With the DoDI 5000.2 update, "alpha-innovating" has a chance to become reality, with the PM at the helm from the very early stages of the acquisition process, pulling it all forward.

Innovations come in big and small packages, and warfighters should have the chance to benefit from every possible one of them. Let the role of the PM evolve to meet the challenge of bringing valuable innovations to fruition.

*The author can be contacted at **ann.wong@dau.mil***.

Embracing Tablet Technology in Military Construction

Maj. Edwin H. Rodriguez, USA

A military construction project is a large and incredibly complex undertaking. It requires enormous individual responsibility, considerable planning and constant, highly effective coordination and communication to complete a military construction project successfully.

The Challenge

The time schedule of a construction site's production environment is extremely tight, and deadlines are often missed left, right and center. Then there are budgetary constraints to deal with, in addition to the necessary coordination between program managers, superintendents and construction supervisors.

Rodriguez is the program manager for Laboratory Health Facility Program Office and the project manager responsible for the U.S. Army Medical Research Institute of Infectious Diseases Replacement Project.

Table 1. Examples of Apps for Construction Projects

BIM

goBIM—This app allows you to view BIM models from your iPad or iPod Touch. It works by using a goBIM exporter with your BIM application to create a .gbm file. Then you load the file onto a web server and access it later from your phone, wherever and whenever you want it.

CAD, Design and Drawing

cadTouch R2—This enables you to draw floor plans, land surfaces (and calculate area and perimeter), facades, mechanical or structural parts (and calculate moments of inertia), diagrams, field notes and more. You can then send drawings instantly via e-mail or FTP.

Finger CAD—This app allows you to draw houses, bridges, plans of apartments, mechanical components, geometrical figures and more using your finger. Final designs can be saved and delivered using e-mail. This could be used by engineers, architects, surveyors and students.

iRhino 3D—You can view native Rhino 3DM files with this app. Using typical iPhone commands, you can pan, zoom and rotate. In addition, 3D models can be loaded from websites, Google Docs, e-mail attachments (iPad only) or from iTunes (iPad only).

Document Viewer

iBlueprint—With iBlueprint, you can create and export custom floor plans. It's handy for homebuyers and real estate agents, but can also be used by contractors for quick access to blueprints on the job site. It can be used on the iPhone (OS 3.0 or later), iPad or the iPod Touch.

LEED (Leadership in Energy and Environmental Design)

LEED AP Building Design + Construction—Similar to iBlueprint, this app is designed to help construction professionals study for the LEED AP Building Design and Construction exam. The app includes 200 flashcards and a 100-question practice exam.

Green Pro—This app gives architects, engineers, owners and contractors the ability to access and track LEED credits for new construction and major renovations. Users can access information about credit requirements and indicate when a particular requirement has been met. The app can be used on the iPhone (OS 3.1.2 or later), iPad and iPod Touch.

PlanRoom

Mobile PlanRoom—This is the first official construction app for iPads. It allows architects, engineers and contractors to access drawings from the field without having to carry paper plans. It is designed to synchronize with www.BuilditLive.com, a Web-based software application that allows project members to share drawings, specifications and other electronic information. The app also works on iPhones (OS 3.2 or later).

Project Management

Procore—This allows users of Procore construction software to create, manage and share Procore project data from their phones. Specifically, users can create and manage punch list items, access contact data, share and store project photos, log time card entries and more. The Procore app can be used on iPhones (OS 3.0 or later), iPads and iPod Touch.

The aforementioned coordination between everyone involved is crucial to the proper planning and completion of the building activities. These activities also need to be balanced with inspections, safety and environmental controls, and the accompanying documentation and follow-up actions pertaining to all work, both ongoing and completed.

Furthermore, these people have to juggle orders for building materials and equipment from within their onsite offices, in addition to dealing with the flow of digital drawings between the design engineers and the architects. At the same time, they send numerous e-mails about pending work to subcontractors, and they draft reports about all deviations from the original construction plan and budget.

Finally, there are the inevitable production meetings at day's end, every day, during which notes are taken, transcribed and e-mailed to every stakeholder in the project. Suffice it to say that for a construction project to be realized, production, use, transmission and storage of a vast amount of information—both reliable and current—is absolutely essential. Further compounding the problem, of course, is the need for a wide range of software, communication tools and shared storage servers to maintain the flow of said information.

This information is indispensable because it helps solve all or most on-site problems that arise during construction. However, project managers and construction crews have time and again encountered problems and mistakes that occur in the prevalent system, no matter how cautious they are. The challenge, then, is to discover a solution that allows optimum productivity and efficiency during a construction project, with the bare minimum of mishaps, problems, delays and misunderstandings.

The Solution

The recent approval of the *Apple iOS 6 Security Technical Implementation Guide* by the Defense Information Systems Agency has allowed for the development of an environment that supports a wide variety of operating systems and devices, while drawing from multiple vendors. The solution for the construction industry therefore lies in the host of tablet devices currently available from the U.S. Army's CHESS (Computer Hardware, Enterprise Software and Solutions)

Program catalog (https://chess.army.mil). Each of these tablets is highly capable of being integrated into existing project management systems, having adequately fulfilled the baseline requirements for security, the Trade Act Agreement and environmental protection.

These PC tablets are incredibly effective solutions to the construction industry's woes, as they enable superior real-time management of critical data, thus reducing considerably the time spent on various construction-related activities. In addition, these tablets can incorporate innovative software solutions and apps that project managers find rather easy to use because of their user-friendly design.

Using tablets and appropriate apps, construction site managers have constant access to accurate and reliable data, and can make their decisions confidently with the knowledge that the entire team is using the very same information. They also can use these products to gain access to information about other projects, both past and current.

The Benefits of Tablets

The apps available for PC tablets (see Table 1) offer a range of fundamental benefits that facilitate various aspects of a construction project manager's complex job. Those benefits include the following:

- **Instant Access:** Using apps such as Dropbox and Google Drive, which allow the hosting and sharing of data, the construction crew can instantly access construction documents, including site plans, floor plans, purchase orders, colors and selections.

- **Remote Access:** Tablets allow easy remote access to various kinds of data, such as accounting, estimating, project management systems, purchasing, scheduling and workflow.

- **Remote Meetings:** Construction site personnel no longer need to cross the entire length of a huge site to meet with one another. They can set up face-to-face meetings through video conferencing via apps such as Skype and Apple's Face-Time. This will save time and enhance coordination between builders, suppliers, supervisors and trade partners.

- **Quality Control:** Instant field reports and virtual quality control are now possible, because a superintendent can simply take a problem area's photograph with the tablet's camera and e-mail it, along with notes and plans, to everyone concerned. This should help to identify and address problems at an early stage.

- **Enhanced Efficiency:** The PC tablets streamline the construction project by increasing productivity through constantly effective communication, improving time and budget management, and reducing costs through shorter travel times and the minimizing of errors.

- **Cost Savings:** The benefits from this endeavor will outweigh the overall investment per tablet. Potential cost per unit with apps would be approximately $700. The implementation of this initiative would decrease project schedule cost by 10 to 20 percent. It's affordable, extremely efficient and can be easily spread out among multiple projects.

Conclusion

A military construction project—equipped with the right PC tablet and the accompanying operation system, software and apps—can be brought to a successful conclusion through minimized risks, proactive management, on-budget costs and within-deadline schedules. This will result in greater value to warfighters and taxpayers, while increasing profitability for the contractors. &

The Defense Life-Cycle Logistics Journey

A 10-Year Retrospective of Product Support Transformation

Bill Kobren

"As DoD moves forward with weapon system acquisition reform, attention to product support must be increased, and life cycle management must be better focused to achieve affordable operational warfighter outcomes"

—Dr. Ashton Carter, USD(AT&L), November 2009

The Life Cycle Logistics career field comprises professionals responsible for planning, development, implementation and execution of effective and affordable weapons, materiel and information systems product support strategies. Life Cycle Logistics encompasses both acquisition and sustainment activities spanning a weapon system's life cycle. It is today the third largest Defense Acquisition Workforce career field, made up of more than 17,000 civilian and military personnel from the Army, Navy, Marine Corps, Air Force and a range of Department of Defense (DoD) agencies. It has not, however, always been so.

In the months following September 11, 2001, DoD leadership recognized that what was then called the "Acquisition Logistics" functional community was not where it needed to be. Product support planning too often failed

Kobren *is the director of the Logistics & Sustainment Center at DAU.*
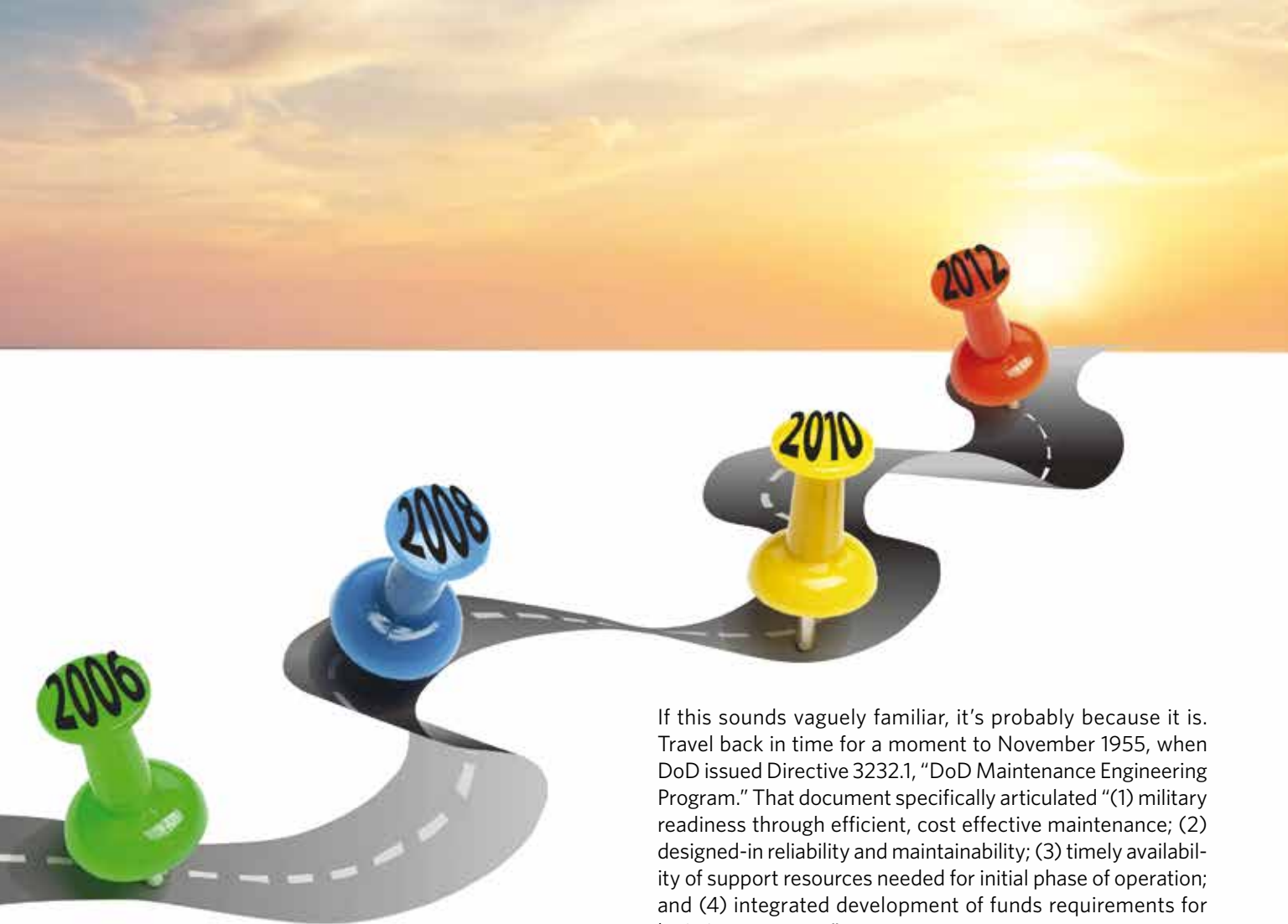
If this sounds vaguely familiar, it's probably because it is. Travel back in time for a moment to November 1955, when DoD issued Directive 3232.1, "DoD Maintenance Engineering Program." That document specifically articulated "(1) military readiness through efficient, cost effective maintenance; (2) designed-in reliability and maintainability; (3) timely availability of support resources needed for initial phase of operation; and (4) integrated development of funds requirements for logistics resources."

to occur in a timely manner, long-term sustainment execution skills were deemed inadequate and, although long espoused, a true focus on total life-cycle systems management was lacking. Not only had gaps in workforce skills emerged, but real concerns existed concerning the workforce's ability to achieve crucial outcomes across a range of rapidly evolving requirements that included:

- Timely acquisition of weapon systems meeting warfighter performance requirements
- Integration of supportability and maintainability during the acquisition process
- Emphasis on early development and delivery of capability to the warfighter
- Weapon system sustainment to meet or exceed warfighter performance requirements at best value to DoD
- Evolutionary acquisition with early life-cycle emphasis on designed-in reliability
- Intense pressure for systems that can perform and are inherently reliable
- Continuing assessment of sustainment strategy to improve reliability and maintain optimum performance
- Life-cycle focus on logistics considerations both up front and in sustainment

Two decades later, in a 1975 paper titled "An Historical Review of the Integrated Logistic Support Charter," future-Air Force Gen. George Babbitt reviewed the previous 20 years of DoD policy and guidance. He identified "two basic objectives of [what was then called Integrated Logistics Support, or ILS]: (1) Increased supportability of weapons through early consideration of logistics in design, and (2) more efficient logistics support through integrated management of the logistics elements during acquisition." While the terminology has evolved from "integrated logistics support" to "integrated product support" (and from logistics elements to product support elements), in recognition of the multidisciplinary nature of the field, the principles that constitute the foundation of this functional community have remained remarkably consistent for nearly 60 years.

Indeed, then-Maj. Babbitt went on,

… the concept of ILS was formulated by the Services and industry during the late 1950s and early 1960s. Formal DoD policy was first issued as DoD Directive 4100.35 in 1964. The Services were directed to manage the previously independent elements of logistics as an integrated whole and to make logistics a primary consideration from the conceptual phase through the operations phase.

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Despite having been written 50 years ago, the standard of "maximum material readiness and optimum cost effectiveness" serves as a prescient vision that guides virtually everything this community is about to this day.

The 1964 DoD Directive 4100.35 in fact stated,

> ... the primary objective of this Directive is to assure that the development of effective logistic support for systems and equipment is systematically planned, acquired and managed as a whole (by Interlocking the elements of logistic support) to obtain maximum material readiness and optimum cost effectiveness.

Despite having been written 50 years ago, the standard of "maximum material readiness and optimum cost effectiveness" serves as a prescient vision that guides virtually everything this community is about to this day.

While none of this was new, the DoD still recognized the need to get back to the basics of life-cycle-management practices and principles. Although preliminary changes were under way as early as 2002, with establishment of a sustainment track in the Acquisition Logistics workforce certification requirements, the transition did not begin in earnest until a year later. The culmination came in 2004 with the issuance of a definitive "Life Cycle Logistics Workforce Changes" memo from the Assistant Deputy Under Secretary for Logistics Plans and Programs. The memo stated that "continued evolution of acquisition and logistics transformation, together with the reengineering of the DAU logistics curriculum, make it appropriate to move to a unified Life Cycle Logistics Career Field, Career Path, and Training."

The dissolution of the Acquisition Logistics career path, as longtime practitioners had known it, not surprisingly coincided with a major refocus across the department on life-cycle management, concurrently manifesting itself in a series of new guidance issuances and policies governing acquisition. These included revisions to DoD Directive 5000.01 and DoD Instruction 5000.02, a new *Defense Acquisition Guidebook* and the advent of the Joint Capabilities Integration and Development System (JCIDS), to name just a few.

Moreover, by the early years of the last decade, the Acquisition Logistics workforce had dwindled in size to just over 10,000 due in part to workforce cuts during the 1990s. At the risk of overgeneralizing, those who remained tended to focus on early stages of the life cycle and too often possessed insufficient experience overseeing increasingly complex technical or sustainment-planning activities necessary to achieve efficient and effective long-term product support outcomes. It was in this context that the DoD undertook the most significant changes to this functional community in more than a generation. In the process, over the next 10 years, workforce size, composition, quality, expectations and professional development were completely transformed.

The strategic imperative behind this transformation, perhaps best articulated in the November 2009 "DoD Weapon System Acquisition Reform: Product Support Assessment," was also crystal clear: "... product support considerations, germane to both acquisition and logistics, are necessary throughout the DoD life cycle framework, beginning with early requirements determination and continuing through system design, development, operational use, retirement, and disposal."

As a result, as both the 2008 DoD Logistics Human Capital Strategy and the Life Cycle Logistics career field overview on the Defense Acquisition Portal articulate, DoD life-cycle logisticians today perform a principal joint and/or DoD component logistics role during both the acquisition and operational phases of a system's life cycle. This is to ensure that product support strategies meet program goals for operational effectiveness and readiness; that supportability requirements including cost, schedule and performance are addressed consistently; and that supportability considerations are implemented during systems design in order to meet system materiel availability, materiel reliability, operations and support cost, and mean downtime objectives. The ultimate goal is to deliver optimized, life-cycle product support to their warfighter customers. To be successful in this endeavor, they must be cognizant and proficient in seven key areas identified in the 2008 DoD Logistics Human Capital Strategy (HCS):

- Logistics design influence
- Integrated product support (IPS) planning
- Product support and sustainment
- Configuration management
- Reliability and maintainability analysis
- Technical/product data management
- Supportability analysis

Life-cycle logisticians achieve this by pursing two primary objectives, namely to work within their program team to

Table 1. Integrated Product Support Elements

- Product support management
- Design interface
- Sustaining engineering
- Supply support
- Packaging, handling, storage and transportation
- Technical data
- Support equipment
- Maintenance planning and management
- Computer resources
- Training and training support
- Manpower and personnel
- Facilities and infrastructure

ensure that weapon systems are designed, maintained and modified to continuously reduce future demand for logistics; and to ensure effective and efficient logistics support. In so doing, the resources required to provide life-cycle product support must be minimized while meeting warfighter needs and ensuring long-term affordable materiel readiness. Life-cycle logisticians achieve these objectives by implementing the 12 IPS elements (Table 1) to maximize supportability, reliability, availability, maintainability, mission effectiveness and affordability of the system throughout its life cycle. They influence system design and provide timely product support capabilities that drive effective, best–value, product support planning and execution. Emphasis is placed on ensuring materiel readiness at optimal life-cycle costs and on integrating life-cycle-management principles by designing and implementing performance-based, life-cycle, product support strategies. Life-cycle logisticians can work directly in a program management office, in support of the program manager or in other supporting and sustainment logistics activity offices. They also can serve as product support managers, which we'll discuss in greater detail in a moment.

Fast forward to the present. So what exactly changed over the last decade, how did we get here and, perhaps most important, why does it matter? In short, the answer to the first question is that *pretty much everything changed*. In the process, key DoD policy and guidance, life-cycle logistics competencies, workforce professional development standards, Defense Acquisition Workforce Improvement Act (DAWIA) certification requirements and DAU learning assets were so transformed that today's product support landscape would have been nearly unrecognizable to practitioners at the turn of the last century.

Workforce Composition, Competency and Size

Because a qualified, motivated, trained, proficient and right-sized workforce is essential, first and foremost, to achieving required life-cycle product support outcomes, the DoD and Services focused their attention on the personnel tasked to carry out this part of the mission. However, transforming the functional community from Acquisition Logistics to Life Cycle Logistics was just a start. This was followed by key workforce composition, proficiency and competency initiatives including:

- Targeted workforce growth across the Services and DoD agencies of nearly 40 percent has occurred since 2004 (Table 2). While "more is not necessarily better," it is imperative to have the right people—with the right skills, expertise, training and experience—in the right organizations and at the right locations. To the Services' credit, in an early example of "doing more without more," the vast majority of this growth was accomplished without new hires or expansion of the government workforce, but rather through thorough evaluations and targeted coding of existing logistics positions.

- A full-scale revision of career field competencies in 2007–08, as part of the HCS development effort (http://www.acq.osd.mil/log/sci/hcs.html), focused on significantly improving integration across both the acquisition and logistics domains. DoD revalidated its commitment to the HCS vision in its July 2010 DoD Logistics Strategic Plan, calling for an "integrated, agile, and high-performing future workforce of multi-faceted, interchangeable logisticians able to succeed in a joint operating environment."

- Building on this foundation, DoD conducted an update in 2011–12 that continued to refine the Life Cycle Logistics career field competencies. This time DoD directly aligned requirements with each of the 12 IPS elements and addressed product support gaps outlined in the November 2009 "DoD Weapon System Acquisition Reform: Product Support Assessment." The result was issuance in 2012 of workforce competency requirements regarded by many as the most comprehensive, interdisciplinary and well integrated of any Defense Acquisition Workforce career field (https://acc.dau.mil/CommunityBrowser.aspx?id=635971&lang=en-US).

- Each of the Services has continued to review its respective life-cycle logistics workforces to ensure that they collectively have the requisite skills, authorities, and numbers in the right organizations to succeed. The Air Force, for example, undertook a comprehensive Life Cycle Logistics Workforce Reconstitution initiative beginning in 2007 and a subsequent A3 Life Cycle Logistics Strategic Shift project in 2012, making major Service-wide improvements in workforce professional experience, expertise, assignments and authorizations along the way.

- The April 2013 Better Buying Power 2.0 initiative to "improve the professionalism of the Total Acquisition Workforce" included a series of actions that directly affect the life-cycle logistics community. Among these are the establishment of higher standards for key leadership positions, establishment of stronger professional qualifica-

tion requirements, increased recognition of excellence in acquisition management, and further efforts to increase the cost-consciousness of the Defense Acquisition Workforce.

Product Support Strategic Direction

In addition to life-cycle logistics workforce enhancement, the DoD's underlying product support strategic direction has inexorably evolved over the last decade as well. Although the magnitude of change in the body of statutory, policy and guidance has been substantial, foundational principles of product support and life-cycle management consistently run throughout—and all remain focused on ensuring cost-effective readiness for our warfighters through available, reliable, maintainable, affordable and supportable weapon systems. In addition to DoD 5000 series acquisition policy, four changes in particular stand out as among the most influential:

- A new Materiel Availability Key Performance Parameter with supporting Materiel Reliability and Ownership Cost Key Systems Attributes was established by the Joint Requirements Oversight Council (JROC) in August 2006.

- Signed into law in October 2009, Section 805 of the Fiscal Year 2010 National Defense Authorization Act reiterated the critical nature of both life-cycle management and weapon system product support. This requirement, along with several subsequent updates now codified in 10 U.S. Code §2337, formally established the DoD product support manager position and formed the statutory foundation for subsequent DoD product support guidance and policy.

- Just a month later, in November 2009, DoD issued the comprehensive "DoD Weapon System Acquisition Reform: Product Support Assessment" discussed earlier. This broad-based study evaluated past successes, identified a long-term DoD life-cycle product-support-strategy roadmap, and served as another key catalyst for the rapid evolution in DoD product support that followed over the subsequent four-plus years.

- September 2011 saw the establishment of the requirement for a stand-alone Life Cycle Sustainment Plan (LCSP) "designed to be a tool for programs to effectively and affordably satisfy life-cycle sustainment requirements. This plan articulates the product support strategy, and it must be kept relevant as the program evolves through the acquisition milestones and into sustainment."

Professional Development and Support

With key statute, policy and guidance in place, how has Defense Acquisition University (DAU) responded to this rapidly evolving product support environment? From the perspective of workforce tools, training and professional development, the university sought to remain in lockstep with key stakeholders in the Services, DoD agencies and Office of the Secretary of Defense. For learning asset development, DAU applied proven integrated product and process development strategies. The aim was to reduce the time between establishing new requirements and deploying learning assets to ensure the workforce has access to the most current information. Consequently, virtually every learning asset the university offers is either new or substantially revamped.

The first phase of a two-part transformation of DAU life-cycle logistics training (2003–2008) focused on supporting the DoD-mandated migration from Acquisition Logistics to Life Cycle Logistics. This was accomplished by incorporating life-cycle management, addressing DoD Performance Based Logistics proficiency requirements and integrating acquisition and sustainment through the launch of a series of new training courses beginning in 2003.

The second, but no less important phase of life-cycle logistics training focused on incorporating product support management and addressing remaining gaps in technical training requirements. This included the launch of new courses in 2010 (LOG 103: Reliability, Availability and Maintainability), in 2011 (LOG 340: Life-Cycle Product Support), and in 2012 (LOG 211: Supportability Analysis). Additional new courses (LOG 215: Technical Data Management, and LOG 365:

Table 2. Life Cycle Logistics Workforce 2004–2013

As of end of:	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Army	4,936	6,128	6,320	6,545	7,134	7,952	9,045	8,962	8,677	8,104
Navy/USMC	4,156	4,206	4,155	4,219	4,355	4,784	5,219	5,415	5,497	5,538
Air Force	1,379	2,079	1,781	1,700	1,727	1,989	2,427	2,762	2,789	2,859
DCMA	29	29	28	40	29	35	37	91	132	128
DLA	6	9	7	63	39	22	21	21	317	359
OSD/Other	47	42	41	37	77	70	112	118	127	134
Total	10,553	12,493	12,332	12,604	13,361	14,852	16,861	17,369	17,539	17,122

Source: DoD Datamart

Product Support Manager) are both on track to deploy in 2014. In the process, not only did the DAWIA certification requirements evolve, but the annual number of graduates from DAU life-cycle logistics training courses increased a remarkable five fold during this two-phase transformation.

In addition, DAU undertook development and refinement of a series of Web-based tools to assist the workforce by providing 24-7 access to on-the-job resources to enhance knowledge, performance and ultimately mission accomplishment. This effort included the following initiatives:

- DAU established a readily accessible, web-based, continuous learning module portfolio, which has grown from just two modules a decade ago to 53 today (with four more currently in development). Student graduations from these topical training opportunities increased from just a few hundred a year to more than 47,000 annually by 2013.

- In the five years since its 2009 launch, the number of Life Cycle Logistics ACQuipedia articles has grown from none to 82 today, with thousands of workforce members leveraging the site's resources each year.

- Since its initial deployment in April 2012, the DoD Product Support Analytical Tools Database has cataloged more than 330 tools, with more than 187,000 visits in its first 22 months of availability.

- Completely revamped in late-2013, with more than 3,000 knowledge objects and more than 25 million lifetime page views, the Life Cycle Logistics Community of Practice (https://acc.dau.mil/log; Figure 1) remains the single most visited of the more than 50 communities on the Acquisition Community Connection. Coupled with a new interdisciplinary Performance Based Logistics Community of Practice (https://acc.dau.mil/pbl), launched in February 2013, life-cycle logisticians have one of the most comprehensive, cross-functional repositories of on-the-job product support resources available.

Figure 1. Life Cycle Logistics Community of Practice (LOG CoP)

- The December 2013 deployment of an entirely new IPS element-based *Core Plus Development Guide* will assist workforce members in identifying targeted, multidisciplinary, continuous-learning training opportunities.

- Nearly 600 topical and timely life-cycle logistics-related posts on the Defense Acquisition Portal since August 2009 are aimed at keeping the workforce cognizant of current initiatives and issues

- The deployment of a comprehensive suite of product support performance-learning tools since 2010 includes a *Product Support Manager (PSM) Toolkit*, a dedicated Life Cycle Logistics chapter in the *Program Manager's eToolkit*, a Web-based *LCSP Outline*, and a comprehensive joint service DoD *Integrated Product Support Implementation Roadmap*.

Where Next?

Clearly, the transition from the Acquisition Logistics to the Life Cycle Logistics functional career field back in 2003–04 was merely a first step, albeit critically important. It is impossible to overstate the importance the DoD today places on life-cycle management, on integrated and interdisciplinary product

support, and on designing for reliability, maintainability and supportability. Given how much has been achieved over the last decade, it would be easy to simply declare victory, "rest on our collective laurels," or throttle back as budgets decline. The reality, however, is that product support and sustainment still constitute the majority of weapon system life-cycle costs (and the majority of those costs generally is locked in early in system design and development), and so our task as DoD life-cycle logisticians, as product support managers, or as defense acquisition professionals, is never done. Because much work still lies ahead, the transformation continues unabated. The great news, however, is that past successes have laid a solid foundation for future success as we move forward.

So you may again ask, where next? While none of the philosophical underpinnings of life-cycle management or product support are truly new, it is imperative that the focus remain on optimizing system availability and affordability. It is essential to increase focus on "should cost" savings derived from innovative, outcome-based product support strategies. Our workforce must understand how to develop and implement product support strategies that optimize system readiness and system support costs. We must understand how to conduct supportability analysis in order to drive reliability and maintainability into system designs. We must seek to leverage emerging technologies to drive greater efficiencies and effectiveness. We must continue to work to enhance the quality, expertise and capabilities of the DoD life-cycle logistics workforce. Continuing to drive greater cross-functional, interdisciplinary integration across both the Defense Acquisition Workforce and across DoD logistics, we must seek every chance to inculcate life-cycle-management thinking throughout the defense acquisition and sustainment culture.

To workforce members we say, seize every opportunity to improve your knowledge, skills and breadth of experience. Leverage the extensive training and knowledge resources available to you. Seek out experienced mentors and trusted leaders to guide your professional development. Strive to grow your interdisciplinary skills, perhaps by seeking secondary certification in another functional discipline. If you're not one already, work to become a true subject matter expert, sought out by your boss, peers and subordinates as a "go-to" source of knowledge. Take every opportunity to drive unnecessary costs out of product support strategies, eliminate inefficiencies, improve processes, and enhance system readiness. In the current budgetary environment, such initiatives are not just important, but essential.

For those of us here at the schoolhouse, refining, maintaining, sustaining, integrating and enhancing the existing portfolio of DAU learning assets is imperative for ensuring that the Life Cycle Logistics community—and indeed the entire Defense Acquisition Workforce—has the very best and most current resources, references, tools and training. Continuing to grow the expertise and capabilities of our workforce by establishing stronger professional qualification and experiential requirements will play an even greater role in the coming months and years.

Perhaps most important, the answer to the question "where next?" must be to collectively provide both the American taxpayer and our warfighter customers with efficient and effective combat capability that ensures current and future mission success.

*The author can be contacted at **bill.kobren@dau.mil**.*
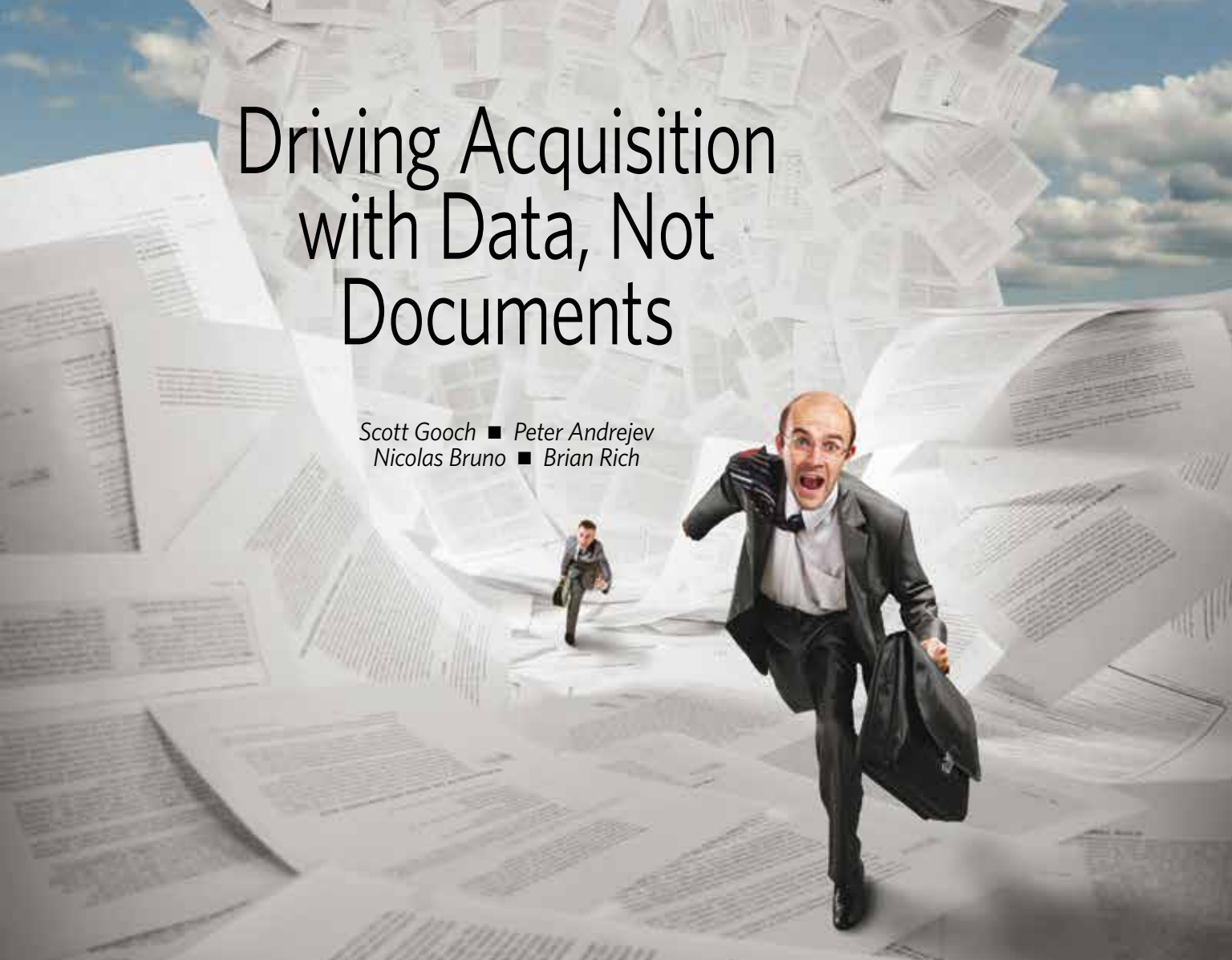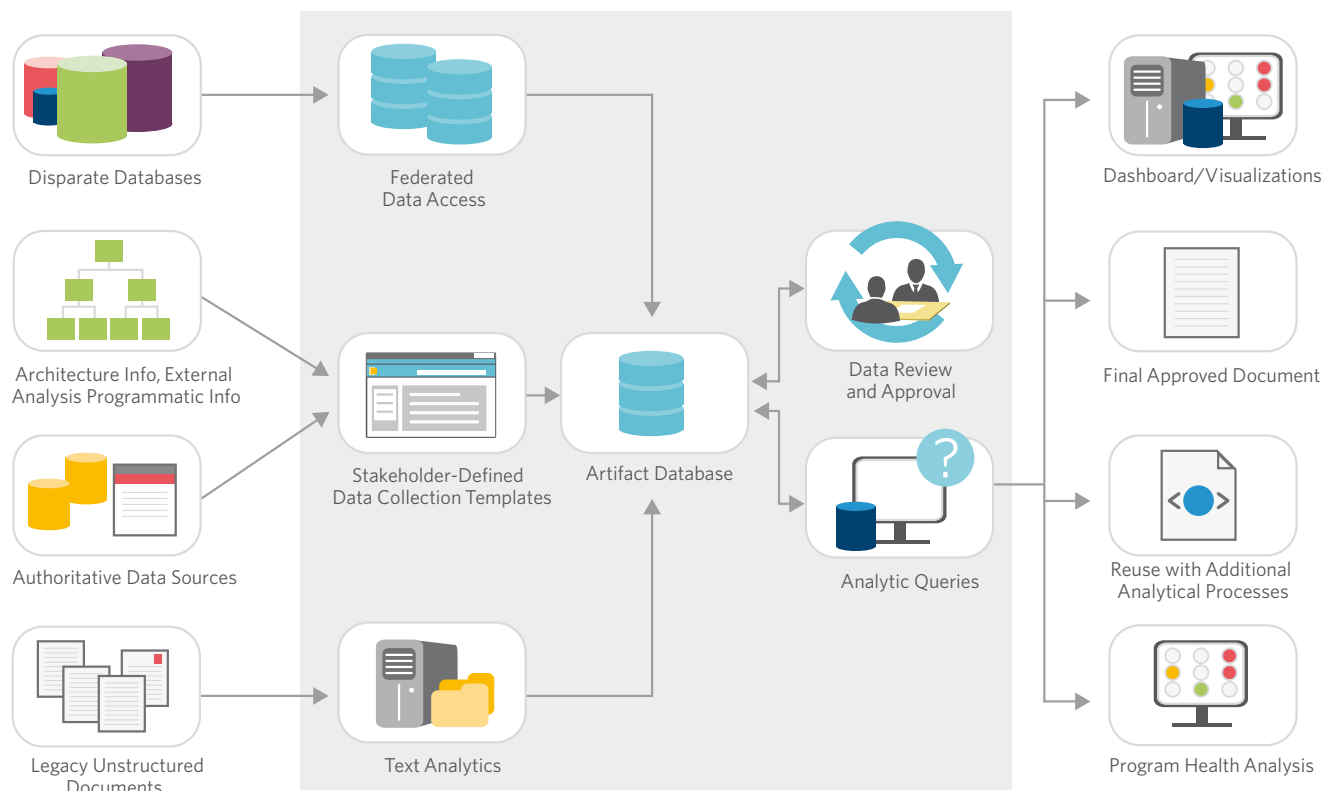
Driving Acquisition with Data, Not Documents

Scott Gooch ■ *Peter Andrejev*
Nicolas Bruno ■ *Brian Rich*

The Department of Defense (DoD) builds the most technologically complex weapons and communications systems in the world today, yet the government officials charged with overseeing these programs rely mostly on manual, paper-based processes to create the acquisition plans and analyses needed to manage these programs. Not surprisingly, collecting information for the dozens of acquisition documents required during a program's life cycle is labor intensive and time consuming. Documents shuttle back and forth among groups of creators, reviewers, approvers and other stakeholders, often introducing unintended but consequential inaccuracies as they add their personal and positional insights when refining these program plans. Version control can be a nightmare. Worst of all, decision makers are unable to fully exploit the valuable troves of program information because

At Booz Allen Hamilton, **Gooch** *is a vice president in the firm's Defense Group, and he leads the accounts for the Defense Threat Reduction Agency and Office of the Under Secretary of Defense for Acquisition, Technology and Logistics;* **Andrejev** *is a principal in the Strategic Innovations Group;* **Bruno** *is a lead associate in the Defense Group; and* **Rich** *is an associate in the Defense Group.*

Figure 1. Acquisition Document Streamlining Process

Disparate Databases

Architecture Info, External Analysis Programmatic Info

Authoritative Data Sources

Legacy Unstructured Documents

Federated Data Access

Stakeholder-Defined Data Collection Templates

Text Analytics

Artifact Database

Data Review and Approval

Analytic Queries

Dashboard/Visualizations

Final Approved Document

Reuse with Additional Analytical Processes

Program Health Analysis

the process creates innumerable separate and often conflicting data sources, rather than authoritative and searchable information sources.

The Pentagon's Better Buying Power and Better Buying Power 2.0 initiatives advocate reducing costs and improving decision making by eliminating unproductive acquisition processes and bureaucracy. A sure way to achieve these goals is by moving from current paper-based, document-centric acquisition processes to a data-centric, IT-enabled strategy. In such a strategy, program officials would create authoritative text once and then promulgate it through the use of a scalable data structure, XML tagging and indexing, Web services and federated output scripts. A Web-based process not only would streamline document creation and improve content accuracy, but would strengthen decision making by giving DoD officials access to the most up-to-date information more quickly and easily. It would also move the focus of reviews from a scrutiny for minor inconsistencies and formatting problems to a high-value exchange regarding meaningful content.

Implementing Data-Driven Acquisition

The document-driven acquisition process is designed to help Pentagon officials manage programs and ensure their readiness to move through designated phases, called milestones, from initial development to production, deployment and sustainment in the field. Today, dozens of "information requirements" for a major defense acquisition program necessitate

numerous approvals from the Office of the Secretary of Defense during the program's life cycle. This has given birth to a cottage industry predicated on the creation, revision and perpetuation of stove-piped acquisition documents at the expense of cohesive, integrated program information and plans.

What would a Web-based, data-driven environment require? The requested data would have to be standardized for consistency across the acquisition life cycle of a program. Legacy document owners would have to develop business rules to guide the artifact creation process. That could be done by identifying the authoritative sources from which to pull data, the sections within their artifact to receive transferred data and the dependent acquisition artifacts to populate shared data. This would allow for the creation of a Web interface—programmed similar to tax preparation software—that would support the efficient and rapid collection of data at its originating sources with the expectation of extensive reuse to eliminate inconsistencies, redundancies, omissions and errors. Just as a Social Security number is prepopulated on all subsequent tax schedules using tax preparation software, the program description data can be automatically prepopulated throughout all of the dozens of acquisition artifacts. This would save significant time, given that up to 40 percent of DoD acquisition documents have common content.

Program reports and analyses could be quickly constructed with the most up-to-date and accurate information. Overall,

the new process would shift the focus from the creation of individual documents for milestone events to the creation of shared information to support online review, analysis and timely decision making.

Is it realistic to think the Pentagon could create a Web-based, data-driven environment across all of its acquisition documents? Yes, it is. This change may not happen quickly, but it is imminent. Past attempts have been limited in several different ways: in their integration (separate Web-based collection, report generation or status dashboard tools versus dynamic Web-enabled data sharing), in their functionality (information retrieval versus information development, submission, review, comment and response, approval, and analysis), or in their scope (applied to a single document versus information sharing across multiple acquisition artifacts). As so many government and commercial organizations have learned, the cost of using paper-driven processes is too high to continue, while the payoff from moving to a digital environment is too high to ignore. So the question becomes, will an end-to-end, data-sharing acquisition environment (see Figure 1) be led by courageous program managers seeking to ensure consistency among their acquisition artifacts, by a frustrated review organization desiring to minimize the staffing cycle, or by a matrixed functional group pursuing economies in artifact development?

Creating a Data-Driven Information Support Plan

A DoD effort to digitize the Information Support Plan (ISP) illustrates the benefits of creating Web-based acquisition artifacts. The ISP identifies and resolves the interoperability, supportability, information sufficiency and net-centric compliance issues and risks that can limit a program's ability to meet its operational requirements. The DoD chief information officer (CIO) initiated an effort to digitize development of the ISP for two primary reasons: to make it easier for program officials to collect the required ISP information from DoD components, and to exploit the full value of the data collected. The CIO tapped Booz Allen Hamilton to help move the ISP from a paper-based, document-centric process to a collaborative, Web-based, data-centric one, which led to the creation of the Enhanced Information Support Plan (EISP). The EISP provides users with a Web interface that facilitates efficient and rapid collection of ISP data from all relevant stakeholders. The automated system standardizes the captured data and enables users throughout DoD to create, search, discover, retrieve, reuse and analyze ISP data, thus supporting timely analyses and reports for multiple DoD stakeholders.

More than 800 DoD programs have used the EISP to generate their ISPs. Program managers have estimated that the EISP's streamlined process for data collection has saved up to one-third in labor costs versus the legacy ISP document process. Reviewers stated that EISPs were more thoroughly written and included more required details than legacy ISPs. In addition, the effort required to assess EISPs was reduced because the comment-and-adjudication process allowed real-
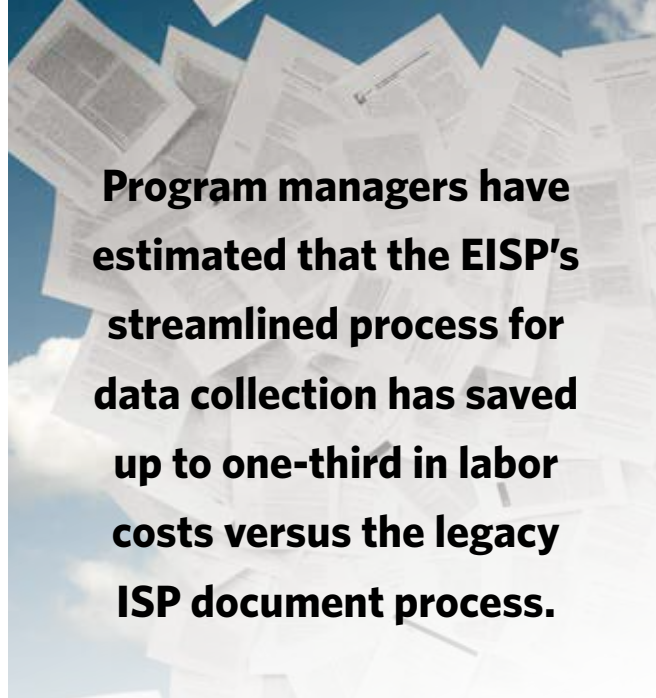
Program managers have estimated that the EISP's streamlined process for data collection has saved up to one-third in labor costs versus the legacy ISP document process.

time dialogue between program managers and reviewers. In addition, the auto-staffing of EISPs streamlined the oversight process by reducing the time required to provide documents to the reviewing community.

Give Program Managers 21st-Century Tools

Managing DoD programs is more difficult than ever, as evidenced in a March 2013 Government Accountability Office (GAO) report, "Defense Acquisitions: Assessments of Selected Weapons Programs." The GAO found that 86 of the Pentagon's largest weapon systems are, on average, an estimated 38 percent over budget and 27 months behind schedule in delivering initial operating capability. Obviously, many factors contribute to these problems, and no single remedy will solve them. Yet, creating automated tools for collecting, sharing and analyzing program data would significantly enhance decision making. It would do this by arming program officials with the most accurate and up-to-date information, leading to more powerful insights that could anticipate and mitigate program risks.

We recognize that the ultimate goal of digitizing all acquisition documents is too complex to tackle as a single, all-or-nothing effort; however, replicating what the CIO's office did with the ISP is quite achievable. It is even possible that acquisition officials could standardize a group of documents that share a high percentage of data elements. The EISP initiative has demonstrated the feasibility and value of such an effort. In a world of fast-changing technologies, threats and mission responsibilities, creating a Web-based, data-driven documentation process would provide program officials with much needed assistance in managing DoD programs and bringing them to successful completion—on budget, on time and with expected capabilities.

The authors can be contacted at **gooch_scott@bah.com**, **andrejev_peter@bah.com**, **bruno_nicolas@bah.com** and **rich_brian@bah.com**.

U.S.-Coalition Forces and Host Nations

DOTmLPF-P for Contingency Procurements
Part 1

Darren W. Rhyne

This article uses the DOTmLPF-P construct (defined below) usually associated with non-materiel solution requirements analysis to propose recommendations for U.S.-coalition and host nation government (HNG) forces plus host nation vendors (HNV) when conducting procurements for HNG forces using the host nation (HN) industrial base in a contingency environment. These proposals are by no means exhaustive but are intended to provide some major areas to consider when executing an HN-first procurement policy.

What Is DOTmLPF-P?

The acronym DOTmLPF-P stands for Doctrine, Organization, Training, materiel, Leadership and Education, Personnel, Facilities and Policy. These topics together in this acronym are normally associated with the term "non-materiel solution" when conducting capability-based assessments under the Joint Capabilities Integration and Development System (JCIDS, Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01H, Jan. 10, 2012). The *JCIDS Manual* (Jan. 19, 2012) defines a non-materiel solution as "Changes to doctrine, organization, training, (existing) materiel, leadership and education, personnel, and/or facilities, implemented to satisfy one or more capability requirements (or needs) and reduce or eliminate one or more capability gaps, without the need to develop or purchase a new materiel solution." In recent years, a "P" for Policy has been added to the acronym for a more inclusive analysis. The DOTmLPF-P construct also can be used to assess the impacts a new materiel solution will have on DOTmLPF-P, most of which are captured in the logistics functional area's 12 Integrated Product Support elements. In this article, I instead use the DOTmLPF-P construct to provide recommendations for contingency procurement operations in which HNVs are used to supply and/or manufacture products for HNG forces under the auspices of U.S.-led procurements.

Rhyne *is a professor of systems engineering management at the Defense Acquisition University's Capital and Northeast Region, Fort Belvoir, Va. He holds a master of science degree in international relations and a bachelor of science degree in mechanical engineering. He is Level III certified in SPRDE Systems Engineering Management and Science and Technology Management, Level II in Program Management, and level I in Test and Evaluation. He was deployed to Camp Eggers, Kabul, Afghanistan, as chief of local acquisitions from Feb. 20, 2010, to Feb. 13, 2011.*

Policy

Even though the "P" for Policy is the last letter in the acronym DOTmLPF-P, it must be covered first. In general, a policy is a principle or rule to guide decisions and achieve rational outcomes. A policy is a statement of intent that is implemented as a procedure or protocol, which, in my use of the DOTmLPF-P construct, is carried out via Doctrine.

Policy in the form of laws, regulations and other government-approved pronouncements is the foundation for an HN-first procurement strategy. U.S. procurement of products for HNG forces using HNVs (an HN-first policy) must be directly traceable to U.S. laws, regulations and budgets to have legality and top cover. HN-first procurement policy should be expressed at the national and theater/regional level in the form of sections of the Defense Federal Acquisition Regulation Supplement, official statements and memoranda from the U.S. ambassador or other Department of State (DoS) representatives and the coalition force commander, and directive memoranda from the regional U.S. joint-contracting authority. To solidify unity of effort, similar policies should exist among coalition nations and organizations such as NATO involved in a contingency operation that involves nation-building.

In addition, HNG laws, regulations and budgets should be in place to transition U.S.-coalition-led procurements to HN procurement organizations when the time comes to do so. That time must be mutually agreed upon by the U.S.-coalition procurement organizations and their HNG counterparts to ensure a smooth handover. Also, HN and U.S.-coalition policy should not preclude foreign nongovernmental organizations (NGOs), such as Peace Dividend Trust, and foreign companies from partnering with HNVs to help them compete for procurements.

HN Customs laws and regulations should also be in place to allow expeditious importation of materials that vendors need to manufacture and supply products under U.S.-coalition-HNG procurement contracts. In addition, the HN's laws and judicial system must exist to prosecute vendors found supporting criminal or insurgent elements and/or violating other HNG procurement and business laws. This applies equally to HNG procurement personnel who violate its laws, so that HNG and HNV personnel alike know corruption will not be tolerated and that there are punishable consequences for it. Integrity is of paramount importance.

Doctrine

According to the DoD *Dictionary of Military Terms*, doctrine comprises the "fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgment in application." In the context of this article, U.S. and coalition forces should have contracting instructions and manuals in place to carry out procurements for HNG forces using HNVs. To guide the execution of the "Afghan First" policy, U.S. Central Command's Joint Contracting Command published

Two small children herd sheep in the middle of a street in Kabul, Afghanistan. Scenes like this remind us of the clash of cultures in a contingency environment.

an acquisition instruction and the commander of the International Security Assistance Force, Gen. David Petraeus, issued counterinsurgency contracting guidance to encourage U.S. procurements from Afghan vendors.

By the same token, the HNG should have procurement instructions and manuals in place to conduct procurements from its vendors according to its laws and policies. These instructions and manuals should be applied consistently nationwide. In addition, the HNG should permit NGOs access to the HNG procurement organizations and HNVs to improve government-vendor relations, assess the vendor base, and assist HNVs to be more responsive to HNG procurement needs.

Finally, the United States, coalition and HNG should have multiple methods in place to announce procurement opportunities to a wide population of vendors. In nations where the Internet is not widespread or commonly used for procurements, other methods such as newspapers, radio and community bulletin boards might be used to announce procurement opportunities to increase the pool of potential vendors.

Organization

According to the JCIDS Manual, an organization is "A joint unit or element with varied functions enabled by a structure

through which individuals cooperate systematically to accomplish a common mission and directly provide or support joint warfighting capabilities." Organization also is important for an HN-first procurement strategy.

U.S. forces conducting an HN-first procurement strategy should have a dedicated local acquisition (LA) organization, which may be under the Security Assistance Office or the logistics organization (J/CJ-4), that provides the program management function to execute the strategy. There also should be a general officer champion for the HN-first strategy. This will likely be the Deputy Commander for Programs or equivalent with formal ties to U.S.-coalition regional commanders. The U.S. logistics organization (J/CJ-4) must work with the HN logistics organization to receive products from HNVs and U.S. Foreign Military Sales (FMS) cases, then distribute them to HNG forces. Proper reception, inspection, management and synchronization of these products with the HNG force structure needs (quantity, timeliness, etc.) are keys to success. The U.S. financial organization (J/CJ-8) manages budget allocation to the LA organization and Defense Finance and Accounting Service handles payments to HNVs, which is of the highest importance to good vendor relations. The U.S. contracting, finance and LA organizations must work together to manage and execute U.S.-led contracting efforts with HNVs. These must be handled with the utmost integrity, transparency and fairness to withstand the scrutiny of oversight entities such as

a special inspector general for reconstruction and a commission on wartime contracting.

However, an HN-first strategy usually is carried out by more than just military forces. There should be an interagency working group established to coordinate U.S., HN and coalition efforts in developing HN infrastructure, agriculture, manufacturing and other sectors. U.S. membership should include representatives from DoD, DoS, Department of Commerce (DoC), Department of Agriculture and others. NGOs also should be a part of this working group, at least in an advisory capacity. In Afghanistan, we had two such interagency groups. One was the Afghan First Interagency Working Group, co-hosted by representatives from the DoC and DoS at the U.S. Embassy. The other was the Interagency Combined Joint Logistics Procurement Support Board (aka "I+6"), chaired by the head of U.S. Central Command's Contracting Command (a one-star general). The Principal Assistant Responsible for Contracting in Afghanistan led the Council of Colonels, which was the I+6's working group. Both of the aforementioned groups met approximately monthly.

The U.S. LA organization must develop a good professional relationship with the HNG procurement organizations, including understanding how they are organized and their relationships with the rest of their military/police organizations, particularly their logistics and finance components. Do they

function like U.S. program management or developmental planning organizations or are they more purely contracting organizations? This is key to understanding their capabilities and limitations. Principal HNG organizational processes to understand are how procurement requests flow from regions to the headquarters, whether the system is based on customer pull or centrally managed push, and how products are distributed via the HNG logistics system. It does no good if excellently procured items can't get to the customer at the point of use in a timely manner and in the quantity required.

From an organizational requirements and planning standpoint, the U.S. LA and HNG procurement organizations must understand which HN security forces need to be supplied. (Personnel in those organizations are equally important.) In Afghanistan, these HN customer organizations eventually included regular national army and police, training units, local police, national guards, border police, special forces, presidential security and HNG-sanctioned local/tribal militia, all of which required some common and some unique products. Most of these HN organizations were known right away, but a few, like the Afghan Local Police, an HNG-sanctioned local militia at the village level, emerged as the U.S.-Coalition-Afghan security strategy evolved.

Other organizations of great importance include the HNG organization that officially registers and licenses HN and external vendors to operate within its borders and validates HNV credentials. This is crucial to maintaining integrity among vendors to prevent a disbarred individual or company from reregistering under a different name to compete for contracts.

Organizations to assist vendors also are very important. These include the banks through which vendor financing and payments pass and any commerce and trade associations that may exist. NGOs can also be useful in understanding the "ground truth" of the HN industrial base and providing linkages between the Unites States, HNG and vendors.

Training

U.S. procurement personnel should be trained in U.S. procurement laws/regulations in general, and for the contingency in question in particular, to understand the rules governing contingencies. For local acquisition personnel, recommended Defense Acquisition University (DAU) continuous learning modules are CLC 106, "Contracting Officer's Representative (COR) with a Mission Focus"; CLC 206, "COR in a Contingency Environment"; and CLC 222, "COR Online Training." If possible, they should also at least meet the Acquisition Professional Development Program (APDP) certification requirements for Level I in Program Management. Training requirements must be reflected in the contingency operation's Joint Manning Document.

U.S. procurement personnel also should be trained in generating and overseeing service contracts for HN personnel such as interpreters and accountants to assist them in their efforts, plus assisting U.S. forces in generating service contracts needed for support. The training should include generating a performance work statement and an accompanying quality assurance surveillance plan, obtaining the funding through the internal U.S. contingency budgeting process, and providing the contingency contracting organization with required periodic performance oversight reports. DAU's continuous learning module CLC 013, "Services Acquisition," provides such basic training.

HNG procurement personnel from the headquarters to the regional/local levels should be trained in HNG procurement laws and regulations. Training programs may need to be established to expedite this, especially if there has been substantial recent turnover in HNG personnel. In addition, HNG logistics personnel who receive products from HNVs need to be trained to properly inspect, receive, store and distribute those products. A flawless procurement activity will be for naught if the products do not get to those who need them in good condition and in a timely manner.

Another important undertaking for the U.S. LA team may be the training of HNVs to properly respond to U.S. and HNG solicitations. The LA, contracting, comptroller and HNG organizations should develop and execute this training to HNVs together. The U.S. procurement rules and solicitation process may be substantially different than those of the HNG to which the HNVs are accustomed. In Afghanistan, at least three sessions were held for HNVs in 2009–2010 to introduce and train HNVs in how to properly respond to a U.S. contingency solicitation in order to elicit proper, responsive proposals.

HNVs also may need training on how to manufacture products to U.S. specifications and standards under U.S. contracts. This may enable them eventually to market those products outside the HN at competitive prices, but the immediate imperative is for them to make products to the required specifications in the

specified timeframe. HNV workers may need to be trained in reading specifications and instructions for manufacturing and assembly; this may include training in basic HN language and manufacturing-quality concepts, especially in countries where literacy is low. Since translating documentation into the HN language usually is the vendors' responsibility, training on reading U.S. specifications and DoD terminology also may be required.

NGOs and HN industry groups (if they exist) should be engaged in assessing the HN industrial base and assisting with training both HNG and HNV organizations and personnel. Where such groups cannot provide industrial base assessments and training, U.S. personnel may be able to reach back to organizations such as DAU, Defense Logistics Agency Troop Support and Natick Soldier Research Development and Engineering Center for support. According to DAU Directive 704 (May 23, 2012), "Foreign military and civilian employees of a foreign government must apply for DAU courses through their country's training officer, who will coordinate the training request through the U.S. Army security assistance officer in the Office of Defense Cooperation or an appropriate official in the U.S. Embassy." Such training usually is funded through an FMS case, which is processed by the U.S. Army Security Assistance Training Field Activity, the executive agent for the Defense Security Cooperation Agency in those cases.

In support of Operation Enduring Freedom, DAU provided tailored acquisition training to Afghan government personnel via deployed professors before 2010. During my deployment, I also provided a short, tailored requirements development course to Afghan government personnel. DAU partnered with the Defense Contract Management Agency (DCMA) to bring a small group of Afghanistan National Army and Police personnel to the Philadelphia area in spring 2011 for tailored Production, Quality, and Manufacturing training. DCMA representatives then took the Afghan personnel on tours of U.S. defense production facilities.

Conclusion

The DOTmLPF-P construct usually is associated with the JCIDS requirements analysis activities and a DOTmLPF-P Change Request. I assert that it can be a useful tool in preparing for and analyzing an HN-first procurement strategy in a contingency nation-building environment such as the United States experienced over the past decade in Iraq and Afghanistan. While I discuss each area of the DOTmLPF-P construct separately, they are actually interrelated and so interdependent that an HN-first procurement strategy cannot be successfully executed without applying the construct as a whole. However, to be sustainable, such procurements eventually have to be transitioned from the U.S.-coalition to the HNG.

In part 2 of this article, I will discuss the materiel, Leadership and Education, Personnel, and Facilities elements of the DOTmLPF-P construct. &

*The author can be contacted at **darren.rhyne@dau.mil**.*
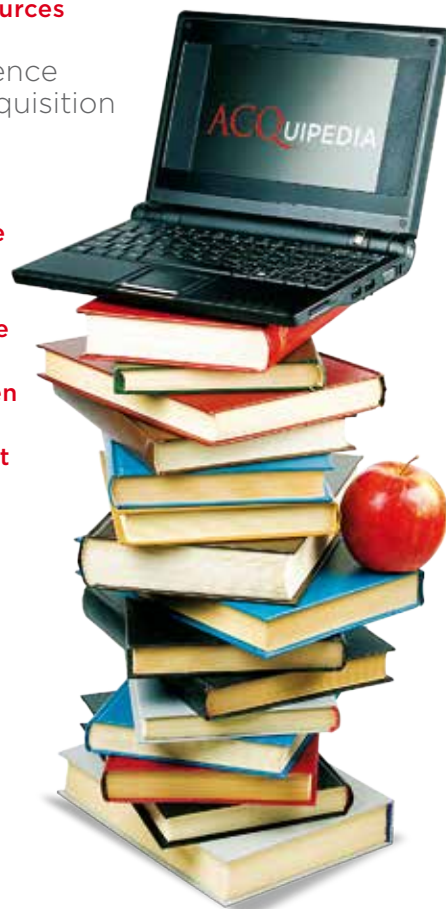
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